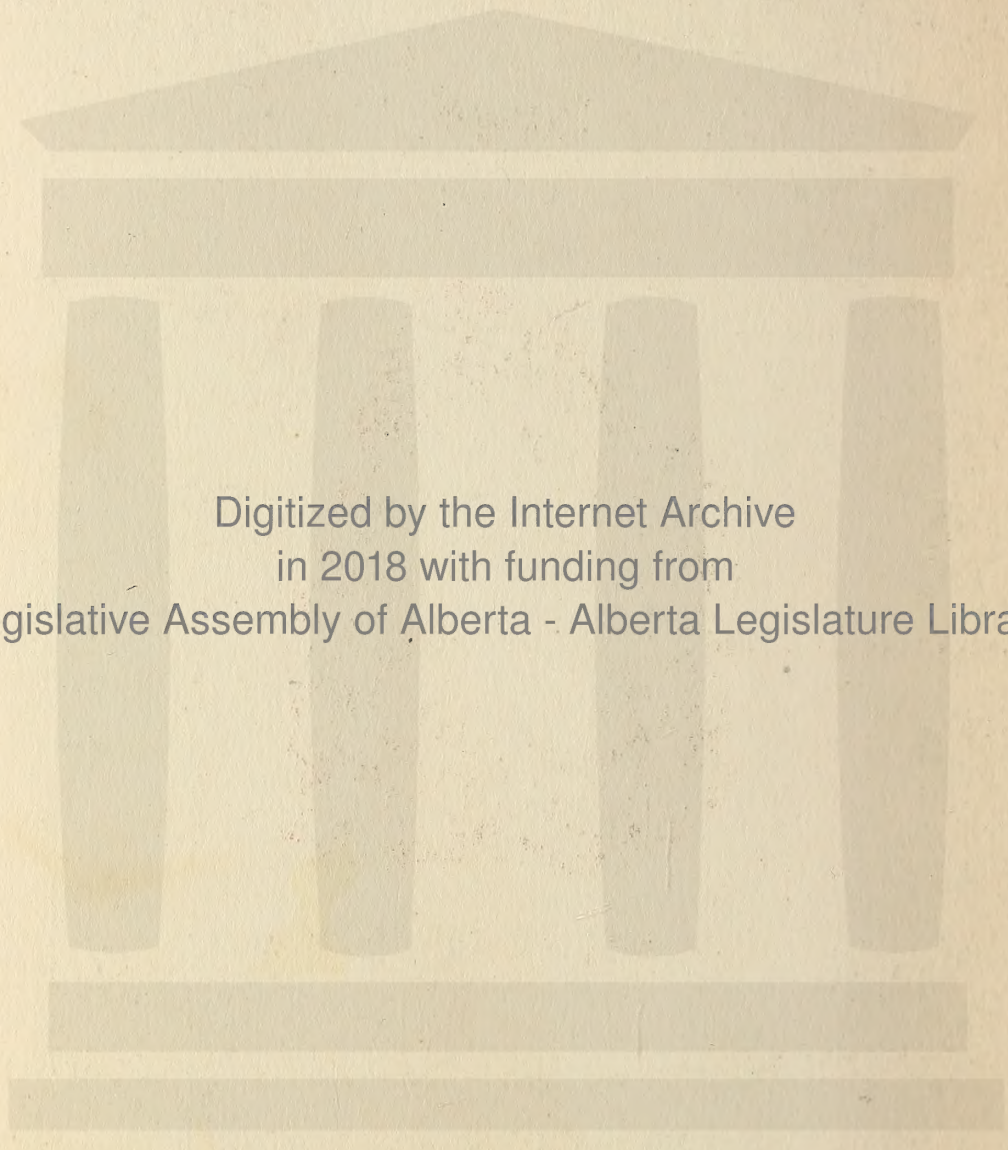
COAL TRUTH

STORED ALBERTA SUNSHINE

The Government of the Province of Alberta

COAL TRUTH OFFICE
277 Smith St., WINNIPEG, MAN.

by
Geo. R. Pratt, Fuel Engineer



COAL TRUTHS

Published by

GOVERNMENT OF
THE PROVINCE OF ALBERTA
Mines Branch

Particularly for the Domestic User so that he may obtain service and economy with the use of the Alberta Coals.

Text and Illustrations by

GEO. R. PRATT, A.M.E.I.C.
FUEL ENGINEER
Province of Alberta
277 Smith Street, Winnipeg, Man.

Price 75 cents

GOVERNMENT OF THE PROVINCE OF ALBERTA
Edmonton, Alberta,
Canada.

September 1922

This book entitled "Coal Truths" is issued by the Government of the Province of Alberta so that it may be of service to the users of the Alberta soft coals, and to supplement the work of the Winnipeg Demonstration Office at 277 Smith Street.

While primarily it was written for the Domestic user, it is also of value to the larger coal buyer, engineers and firemen. Applying the same rules as outlined will result in economy and better service.

While it is not possible here to go into details on the various equipments and appliances for burning the coals, the Winnipeg Office maintains a staff of Fuel Engineers for the purpose of assisting you in any problem which you may have particular to your equipment or fuels.

Statistics quote the Province of Alberta as having 70 per cent of Canada's visible coal resources. While this represents an enormous number of tons of coal, it must be remembered that civilization is using fuel at an alarmingly increasing rate. Therefor the need for economy.

A better understanding of fuel which we hope can be obtained by a study of this issue will obviate unnecessary waste of our fuel resources and assist in putting ahead the time when a substitute for coal as a means of producing heat and power must be provided.

HERBERT GREENFIELD,
Provincial Secretary.

Winnipeg, Man.
Canada.
Sept., 1922

AUTHOR'S NOTE

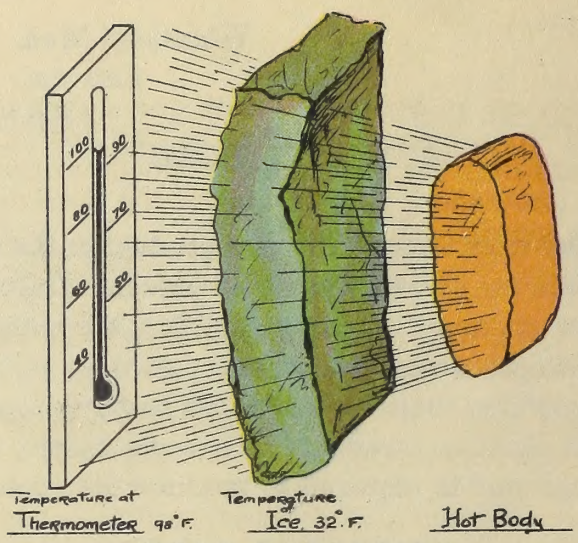
Coal is the most commonly used product in the world, and is used or paid for by every civilized person. Unless some of the wasteful methods of using fuel is abandoned the coal resources will be destroyed forever, as it is not being replaced. It requires thousands of years to form coal, and our intensive civilization prevents the replacement of forests which in large part is required to produce the coal.

It is only during recent years that there has been any organized effort made to use coal economically, and this only on the larger installations. At the present time the average user has very little interest in the product, probably because it is black and dirty to handle. But the Country which can make full use of its fuel resources is bound to be in a favored position industrially and financially.

The text of this book is written in an effort to make the subject understandable to the novice and also to the person who apparently has no wish to understand. Technical detail has been avoided, this can be obtained elsewhere by those who need it.

The illustrations have been made as a result of a number years of study of the action of the fuels. An effort has been made to show by colors the results which occur under the various conditions of the fire. The requirements to obtain these conditions are simple and need very little labor. That the user will take advantage of the results is the desire of

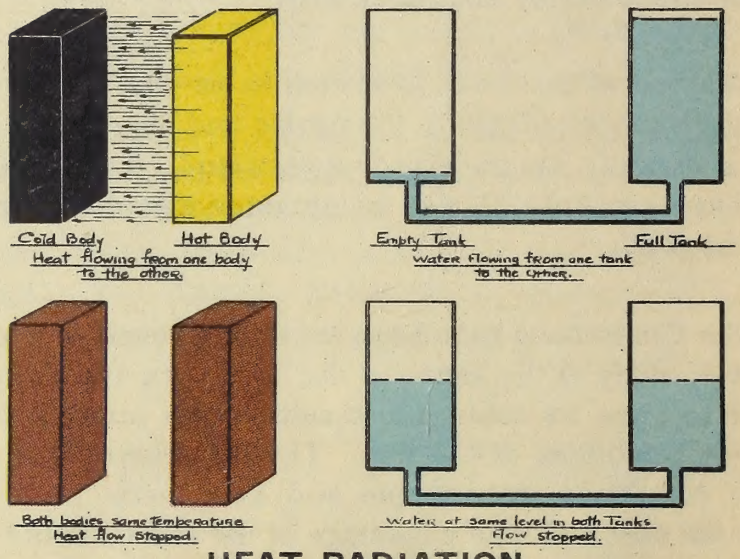
GEO. R. PRATT



HEAT RADIATION

Heat rays will pass through the transparent ice showing greater heat on the thermometer than the temperature of the ice which cannot be raised higher than 32 deg. F.

Plate No. 2



HEAT RADIATION

Heat will radiate from a hot body to a cold body in the same manner that water will find its own level.

Plate No. 3

GENERAL

The following is submitted with the object of domestic heating and fuels being of service to the coal user. Taking the stand that the user knows little about coal and does not wish to know more than is absolutely necessary to give him heating service economically.

KINDS OF COAL

Alberta has a wide range of Domestic coals varying from Anthracite down to Brown Lignite.

There has been no official classification issued on these coals, so that a person starting to use the coal has no record to study in order to determine the probable heating value which he may expect for a given expenditure of money. His only method at present is to "listen in" on the claims made by the various producers and dealers as to the value of the coal which they offer for sale.

Unfortunately there are as many kinds of coal produced in Alberta as there are varieties of pickles, and each variety has in the past been further complicated by new names and descriptions according to the individual pleasure of the Fuel Dealer.

Once that the user has decided that he can obtain the service that he requires, with a particular kind of coal, it is desirable that he continue to use this kind, if heating service and economy is desired. Each kind of coal offered requires different handling to each other kind. One coal may in heat value be greater than others, but if not handled in a manner suitable to its type, it is in results inferior.

What is a B. T. U.

A B. T. U. is the amount or quantity of heat which is required to raise the temperature of one pound of water one degree Farenheit.

When you buy coal you do not buy so many B. T. U's., although your dealer may mistakenly offer you so many B. T. U's.

The coal contains so many "Germs" or eggs, which if your equipment, or incubator, is suitable, and you give it the right attention, will hatch the B. T. U's.

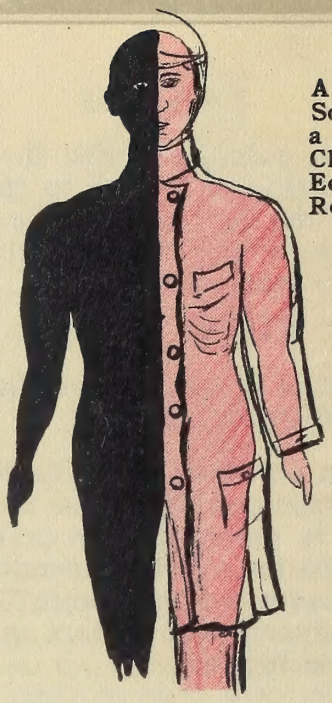
When you buy a "sitting" of eggs they are not sold to

COAL TRUTH

Soot will Keep out Cold so it Must Keep Out Heat

Prevent Soot Forming

But Clean your Heating Surfaces as often as you would if you were making Soot.



A Thin Coating of Soot would Make a Cheap Suit of Clothes and be Economical for Two Reasons.

It would be Cheap and Warm

Plate No. 4

THE EFFECT THAT SOOT HAS

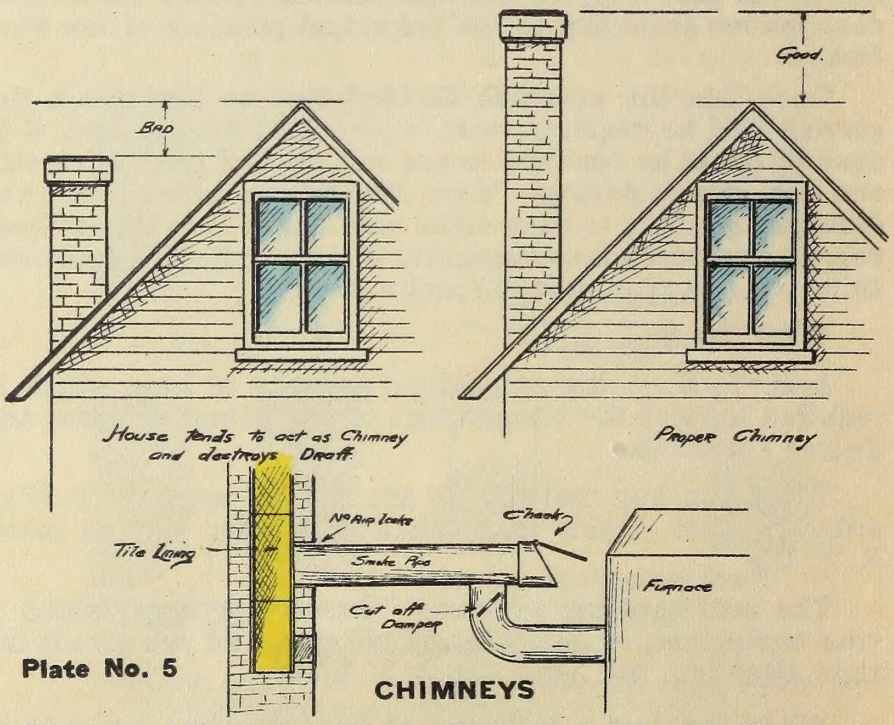


Plate No. 5

CHIMNEYS

Have a good Chimney and Smoke Connections but put in Check and Damper, so that you can make Regulation for saving fuel.

you as chickens. Whether or not they ever become chickens depends upon you and your "Hatchery." Apply this same sense to your coal.

Bear in mind that it is not the heat value that is in the coal that is of value to the user, but it is THE HEAT VALUE THAT HE GETS OUT OF IT. This should be the viewpoint when purchasing coal.

Many of the users have in the past purchased coal upon its "District" name, such as Drumheller. The map, see plate No. 29, illustrates the Drumheller district, and shows the mine names of the coals. The map is a result of the survey made by John A. Allen, Professor of Geology, during 1921. It will be noted that there is only one mine named Drumheller.

In future buy your coal under the mine name. This puts the responsibility up to the mine producing the coal, and will be an inducement to the mine operator to see that his coal is kept to the standard that his name indicates.

In a general way the following will be a guide to the purchaser in arriving at the probable service which he will get from coal from a given district. He must select the kind of coal that appeals to him or from which he has previously had satisfaction, and purchase according to the name which the producer applies to the particular coal from the given district.

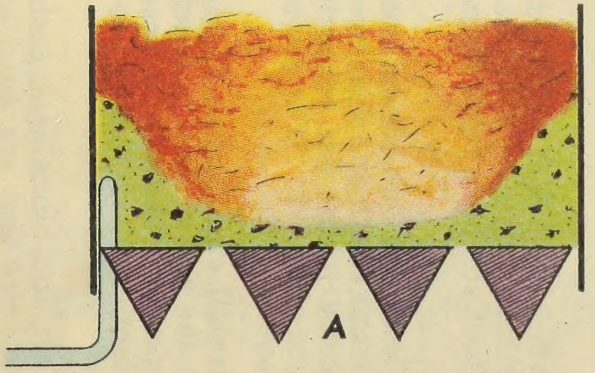
The Saunders, Yellowhead, Foothills and McLeod Fields are bituminous coals which require little attention after properly placing on the fire, providing that you have left a flame to light the gas as formed.

The Lethbridge and Taber Fields are sub-bituminous coals, which contain about equal amounts of ash and moisture. These require little attention if placed in the fire properly and having flame to light the gas as given off. It requires slightly less draft than the bituminous.

The Drumheller, Pembina, Kneehill and Carbon Fields are sub-bituminous coals, in which the ash content is much lower and the moisture content about twice the ash. These require very little draft and no attention after placing properly in the fire-pot.

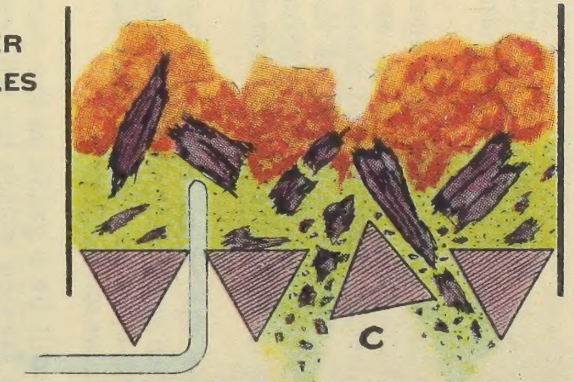
The Clover Bar Field, Dinant, are sub-bituminous coals similar to above, but higher in moisture and are handled in the same way.

The best method of avoiding clinker troubles is to prevent the clinkers from forming.

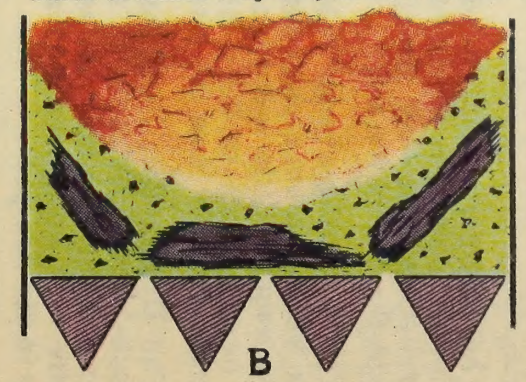


If you allow the ash to collect at the sides of the fire pot you force the centre of the fire which becomes very hot, as shown at A.

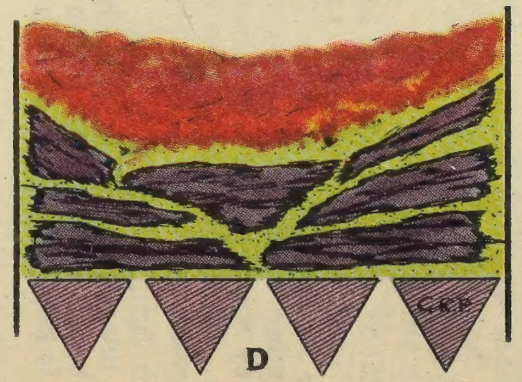
CLINKER TROUBLES



If you should get this condition, get rid of clinkers, as shown at C.



This gradually builds up clinkers, as shown at B.



If you do not, all the ash will be melted to clinker as D.

Plate No. 6

Avoid the use of the poker from the top of the fire, use it as shown here, through the grate bars. The intensity of the colors here, designate the relative intensity of the heat of the fire under the conditions shown.

COAL TRUTH

There are other fields which can be classified by comparison with the above fields as they enter the Winnipeg market.

When making use of the above it must be borne in mind that no definite statement should be made that one coal is better than another. Coal is like any other commodity. The value which the user gets from it depends to a large extent upon the individual make up or his psychologic frame of mind. What is good coal to one is bad coal to another and vice versa.

During the last heating season the author played with the different coals in various domestic heaters, not as an expert to arrive at scientific results, but from the standpoint of the inexperienced user, with the equipment that he would have and the fuels that he would be likely to make use of in same. This, in order to devise some standard set of rules which will be acceptable to, and understandable by the user, with the least possible effort on his part.

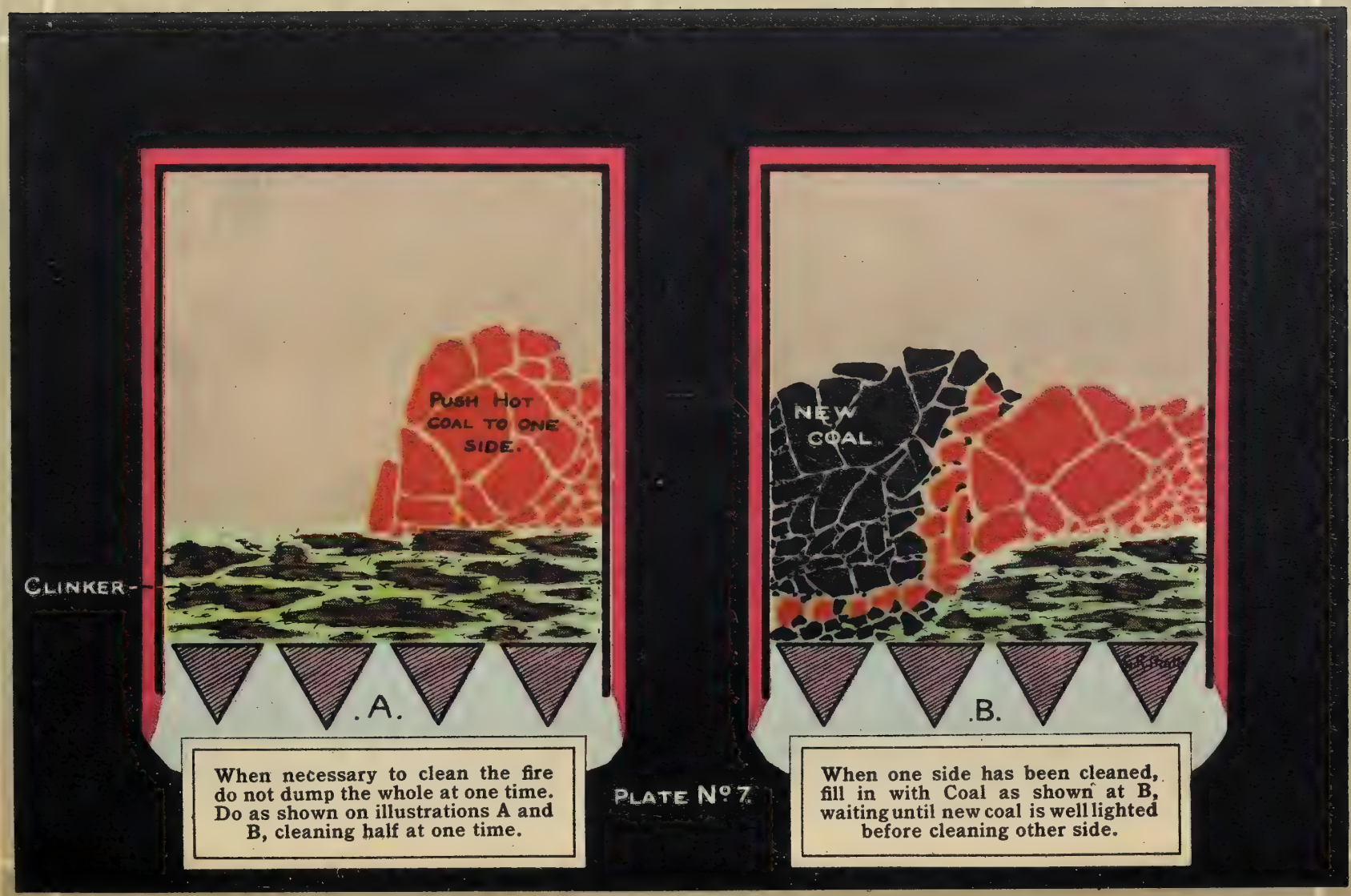
METHOD OF FIRING COAL

The author does not wish it understood that the method of firing the coals from side to side alternately, as shown here, is the only good method. If you are getting satisfactory results by some other method do not change to this.

The method shown here is the result of several years experimenting with all kinds of coals and various methods of placing them on the fire. As a standard it appears to be the best if a person has no best. It is the easiest to understand and put into practice. It allows the condition of all of the fire to be seen. The coal can be placed in position much easier than by using the back and front method, and should a mistake be made by coal falling and putting out the flame, it can be easily remedied.

With this method the combustion chamber is hotter and of more even temperature than with the back and front method.

When the fire is to the front of the furnace, on some types of hot air furnaces the flame does not heat the combustion chamber, but flows around the radiator. This means that the heating surface is reduced, the chimney gases are hotter, more coal is wanted, and there is danger of chimney fire if it is not kept properly cleaned.


PUSH HOT COAL TO ONE SIDE.
CLINKER
A.
When necessary to clean the fire do not dump the whole at one time. Do as shown on illustrations A and B, cleaning half at one time.
PLATE Nº 7.
NEW COAL
B.
When one side has been cleaned, fill in with Coal as shown at B, waiting until new coal is well lighted before cleaning other side.

The following paragraphs will outline in a general way a few laws which should be applied, with brief reasons for such laws. The object being to convey that by following certain rules and *knowing why they should be followed,* that the use of soft coal may be made as easy to handle as anthracite, and that knowing these laws a person may slap in the fuel and go away and forget the fire. At the same time it is very necessary that better fuel economy may be obtained than is the case with anthracite. It is probable that not more than 40 per cent efficiency is obtained in the Domestic Heating with anthracite. We should set as a possible figure for soft coal 55 per cent.

TRANSFERRING THE HEAT OF THE COAL TO THE HOUSE

There are two main methods of transferring heat from fuel to the surfaces to be heated. First by the heat rays which are radiated off the hot fuel on to the heating surfaces. Second by contact of the hot gases generated by the combustion of the fuel with the surfaces to be heated. With hard coal, or anthracite, the radiation rays do most of the work. With the soft coal most of the work is done by contact of the gases with the heating surfaces, especially when coal is first fired and flames intensely.

Heat may be considered on the same parallel as an element, once it is made it cannot be destroyed but must be used or allowed to go to waste. The greatest loss in fuel burning in Domestic use is caused by the gases being allowed to get away without being burned and generating the heat which they should do. This can be seen in the form of smoke.

BURNING THE GAS

All gases to be burned must be heated to a certain defined temperature before they will become ignited, the temperature varying with the kind of gas, for instance the gases off carbon or hard coal require a very high temperature before they are hot enough to burn, while some of the gases off soft coal may be ignited at a temperature as low as the gas off gasolene. It they are not brought up to the required temperature they will pass up the chimney unburned.

As it takes time to break up a gas and to heat it to ignition temperature it will be seen that the longer the flame or gas is prevented from contact with the surface to be heated, the

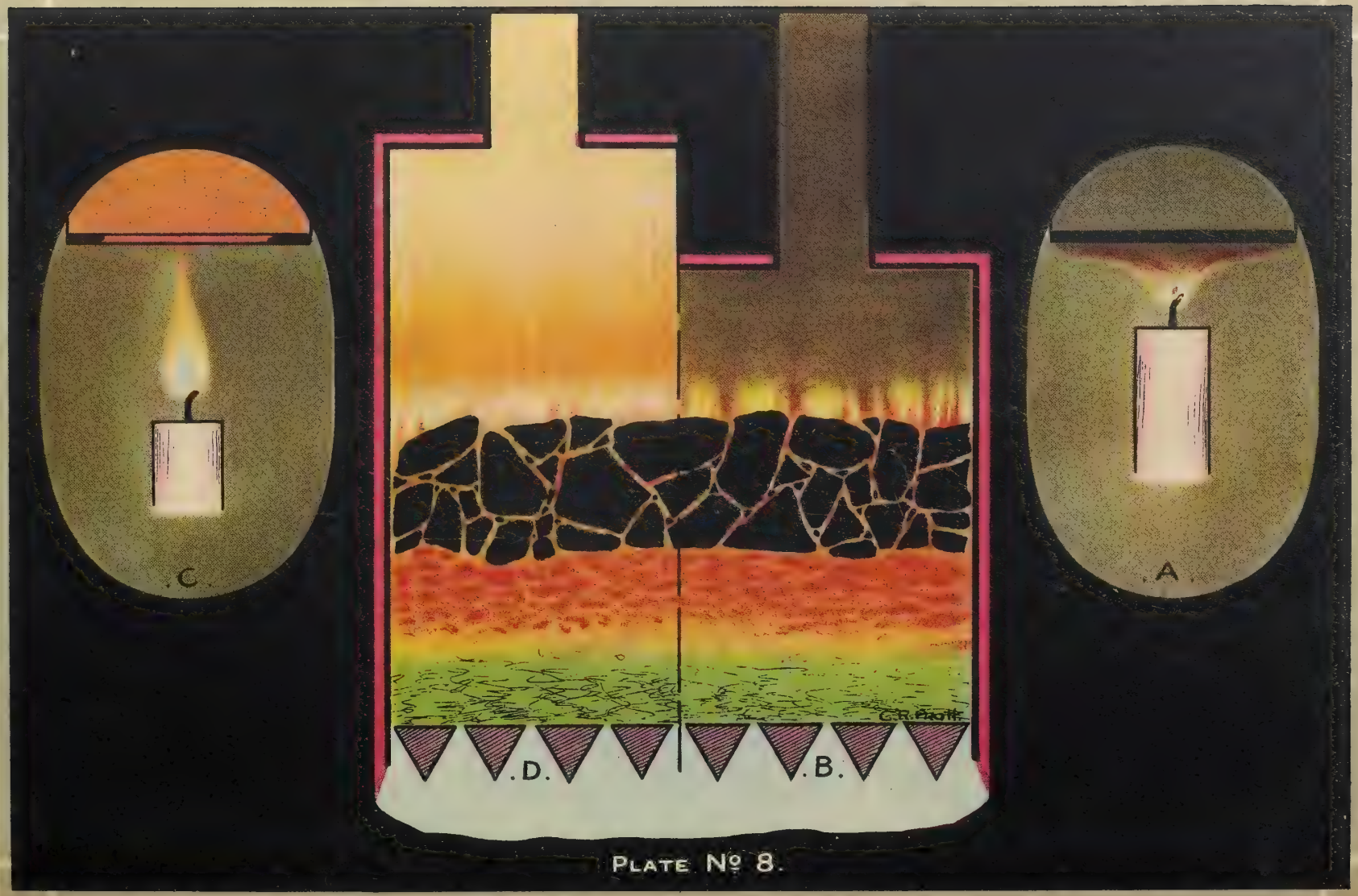


PLATE Nº 8.

greater the opportunity there will be for complete combustion. Contact too early with the heating surface will lower the temperature so that they will be below ignition temperature. This requires a large combustion space, or if you have a small combustion space the flame and gas must be made to travel in such a way that they are lengthened out and kept longer in contact with the fire so that they may become fully heated. As soft coal contains about 50 per cent of its fuel value which must be burned as a gas, the importance of the long flame travel will be seen. This may be accomplished by placing the fuel properly in the firepot. See illustrations.

AIR SUPPLY TO THE FUEL AND FLAME

The next feature which must be considered as absolutely necessary, is the provision of oxygen to the gas, without which it will not burn, no matter how hot you have made it. Air is the medium which supplies the oxygen. The air admitted below the fire through the grate is only sufficient

PLATE No. 8

This Plate illustrates the conditions of the flames in the combustion chamber.

The right hand side of the illustration demonstrates that if the roof of the chamber is too close to the fire there is not sufficient room to completely burn the gas without smoke and soot.

The candle flame alongside illustrates this much clearer.

The left hand illustration demonstrates the improvement in the condition of the flame when more room is provided for the combustion of the gases, and means a great saving in fuel and better heating service. The candle also makes this clearer.

to provide half the oxygen for complete combustion. *This is a Law.* No matter what thickness of fire is used or at what rate of combustion, or in what equipment, only half the oxygen is admitted. If you increase the air under the grate you burn more coal and of course get more heat, but as you supply only half of the air the waste is greater. This feature has a large effect on the liking or disliking of the coal user. With hard coal we will say that you make this condition. As the gas off the anthracite has no color the waste is not seen, and as it requires a very high temperature to ignite this gas there is very little liability of the gas igniting and puffing into the house, but the waste is there just the same.

The cure for this is to supply air to the top of the fire through the holes provided for this purpose in the fire door.

Gas and Smoke leaking into the house. Sooting up the Plate surfaces.

Half of the fuel being wasted while in this condition.

Liability of Explosion while in this Condition

Due to the unnecessary draft under the fire, the fuel will become so hot that when heat is obtained the fuel bed will be too hot for proper control.

Under these conditions there is great liability of making clinker.

This plate illustrates a condition which is frequently the cause of complaints against soft coal. By having too much draft under the fire, the fire is forced. This creates a pressure in the combustion chamber. The chimney is not capable of taking the gases away fast enough and at the same time create suction in the combustion chamber to attract or draw air through the slide in the fire door consequently as no air is supplied the gas will not burn.

The immediate cure for this is to close the draft under the fire, open the air slide in the fire door and push the coal to one side so that a flame will show to light the gas as it is driven off. In a case like this do not reduce the draft at the chimney until the fire has got to normal condition.

Plate No. 9

The regulation which you should make to give you the proper amount of air you must find out by experiment, no rule can be given as no two draft conditions are equal, there is also variation due to outside temperature which will admit more air through a given opening as the outside temperature decreases, the chimney being automatic in its action.

This supply of air to the top of the fire is of more importance with soft coal than with hard. The gas that is being wasted off soft coal can be seen in the form of smoke, and as the gases that are distilled off ignite at a lower temperature they will be more liable to ignite and puff into the house if a continuous flame is not provided, and a flame will not stay lighted unless it has a constant supply of air at all times.

GAS MUST BE LIGHTED

We have established that the fuel makes the gas and that oxygen is required to burn the gas, now we must light the gas. You must arrange your fire so that it provides the match at all times to light the gas as it forms; this is done best by placing the coal on to the fire so that the hot coal is not entirely smothered (see Plates 13 and 14). A lump or two may be placed on any part of the fire leaving flames in between the lumps, but the best way is to place all your new fuel so that a flame may be left to one side, this will allow one side to be kept hot enough to ignite the gas. It will also attract the cooler gas as formed bringing it to the flame, and will also lengthen out the flame travel and so keep the gas in contact with the heat of the fire until ignition is complete.

This is a very important feature as the flames off any coal are longer than the usual height provided in the combustion chamber of the average heating furnace or boiler.

RADIATION

Heat rays radiate from a hot body to a cooler body. The intensity of the rays impinging upon the cool body being dependent upon the distance that the two bodies are apart.

Heat rays are similar to light rays in that they travel in straight lines. If you wish to transfer the heat from a hot body to a cooler body, the hot body must be able to see the cool body, anything obstructing this sight will obstruct the heat rays, they will not go around an obstruction. In similar manner to light, if you place an obstruction in front of the light when you are reading, the only light you obtain is that which is reflected from other bodies in proximity to the light and is not so intense.

Heat rays are also similar to light in that the rays may be

ALL FUEL REQUIRES OXYGEN IN ORDER TO MAKE IT BURN

To burn any fuel you must provide oxygen to the flame. AIR is the medium which conveys this oxygen.

If you do not supply this air the result will be as shown in glass jar No. 2.

Take a glass jar and place a small piece of lighted candle at the bottom see Fig. 1. Now cover the top of the jar entirely stopping the supp'y of air to the candle, the result will be that the flame of the candle will die out. Fig. 2.

When you prevent the supply of air to the top of the fire the result is exactly the same as is shown with the candle.

The slide in the firing door is there to provide the air for the purpose of burning the gas off the coal. Regulate the opening of the slide to suit the condition of the fire and your chimney draft. You may find that you require it wide open when forcing the fire, and about one third open when fire is set for long period.

Determine yourself the amount of opening that is required by noting the changes in the condition of the flame by opening the fire door.

Do not have the slide open too wide as it acts as a check on your heating, too much air will be drawn in and cool the hot gases off the flame you have made by supplying the air.

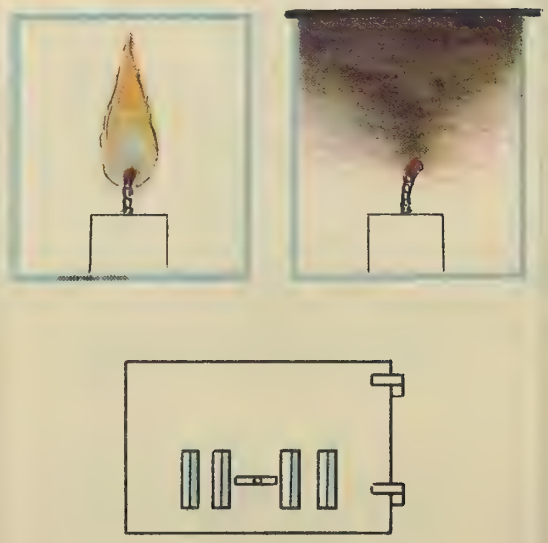


Plate No. 10

The nearer to the bottom of the firing door that the holes are the more effective they will be. If the door has insufficient air holes get several holes drilled in same.

passed through a transparent body without materially increasing the temperature of such transparent body. This may be proved by passing heat rays from a heater through ice on to a thermometer obstructed by the ice. While the ice is ice its temperature cannot be increased above 32 degrees F., yet your thermometer may show a fairly high temperature by the heat rays passed through the ice. See Plate No. 2.

TRANSFERANCE OF HEAT

Heat will flow from a hot body to a cooler body varying as to the difference in temperature of the two bodies and will continue to flow until such time as the cooler body has attained the temperature of the hotter body. This is similar to having two tanks, one filled with water and one empty, connect the two tanks with a pipe and allow the water to flow. After a short time the water will have flowed from one to the other and be at the same level in both tanks, the level having lowered in one tank and been raised in the other. See Plate No. 3. In the same manner a person standing in a warm room with large window space will reflect the heat of the body to the outside, dependent upon the distance from the window and may feel cold. This is often erroneously put down to drafts from the window.

This demonstrates that if a radiator is placed close to a window the loss of heat will be greater if much of the radiator can be seen from outside, which same loss will also be dependent upon the distance that it will be away from such window.

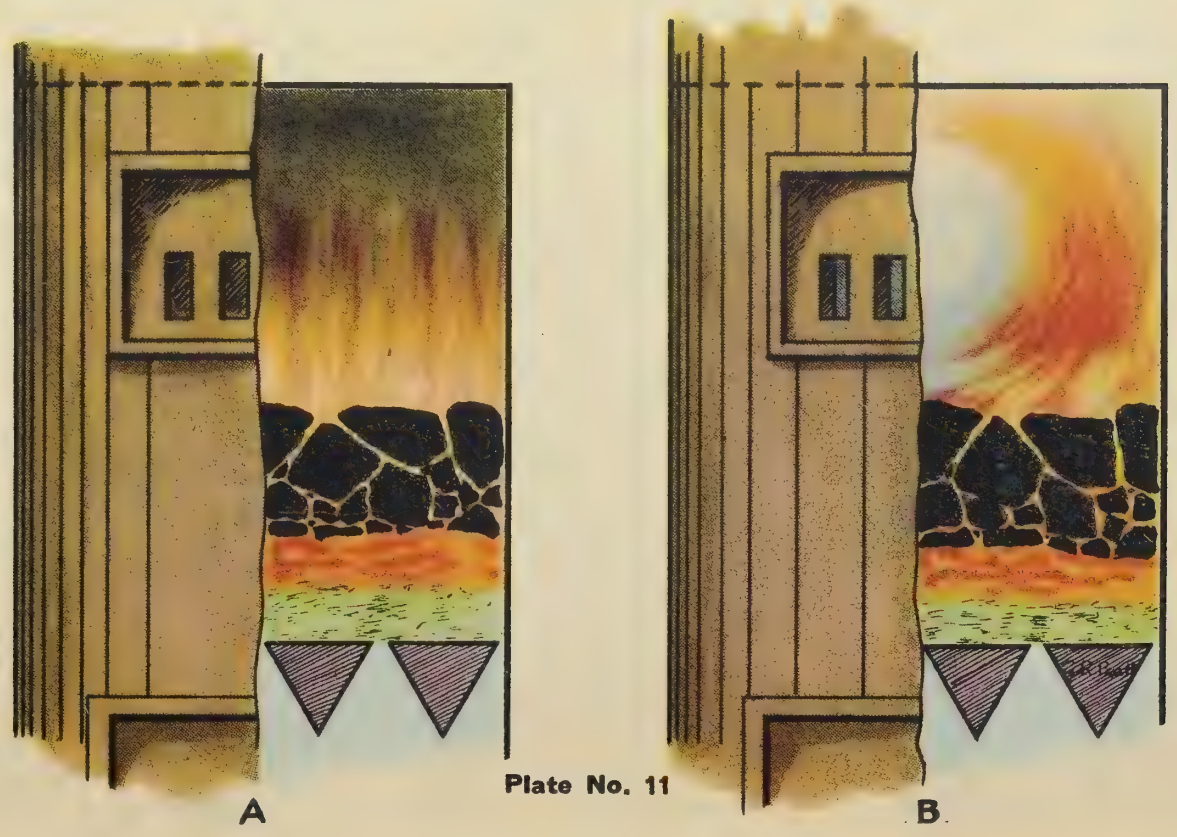
CONDITION OF HEATING SURFACES

In considering the radiation value of any surface it must be borne in mind that heat rays radiate from a body at right angles to the surface, thus from a sphere the lines would be equal in all directions, while from a flat surface most of the rays would leave at right angles from such surface, dependent upon the smoothness of such surface.

The condition of such surface and color of same have considerable effect on the amount of heat radiated from a body, for instance, taking Black for one example with rough surface, the radiation will be 100 per cent, polished silver surface will be 3 per cent, various materials and conditions of surface will vary in between these two extremes.

Another feature which must be considered is the reflecting value of any surface; this is the reverse of its radiating value—polished silver at 97 per cent and black at zero.

If you do not supply air to the top of the fire, you cannot burn the gas, consequently you have waste of fuel, you also make conditions for smoke, soot and gas into the house.



A

Plate No. 11

B

CHIMNEYS AND DRAFT

As the chimney can be the greatest fuel waster the following must be fully understood.

When installing a power boiler for the provision of steam, the chimney is considered as a unit and is made of such size and height as to burn the amount of fuel it is estimated will be required in order to provide the necessary steam.

With the domestic chimney such consideration is not given, usually if the chimney is kept clean and is properly built it has a much greater capacity than the requirements of the house for a steady fire. The only time that the full capacity of the chimney, (or what is so called a good chimney) is desirable is when lighting a fire. At o her times it should be regulated to place it in the condition which you would expect from a poor chimney.

To obtain economy the draft should be regulated to suit the amount of coal burned in a given time, and also the kind of coal being burned. For instance, as hard coal requires a high temperature to ignite it, it requires a higher draft to create this higher temperature. With coking coal, on account of its feature of closing up the air spaces between the pieces of coal as they become heated, it also requires higher draft on account of the comparatively small air spaces compared with the area of the fire pot, also, due to the fact that when the gas has been burned out, the coke remaining usually has a similarity to anthracite coal. Both of the foregoing fuels are slow ignition coals and unless there is a free draft supplied to the fire at all times, the fuel will die out and unburned cinders will be found in the ashes.

The free burning coal however, such as is mostly used in the Domestic equipment, is easily ignited and once the coke has been brought to a red heat will usually remain hot until entirely consumed to an ash. This means that very little draft is required once the fuel has become partially ignited. This in order that the fuel will not burn away too quickly. In this case a poor chimney is the most economical. Not that it is suggested that you build a poor chimney, but you should have same arranged with dampers so that when desired you may put your chimney into a condition similar to a bad one, don't let the chimney become a bad one through lack of attention and proper cleaning, this being a fire risk. In building the chimney, see that the top is carried high enough above the peak of the roof so that it will not be effected by adverse winds. A sheet iron extension to the

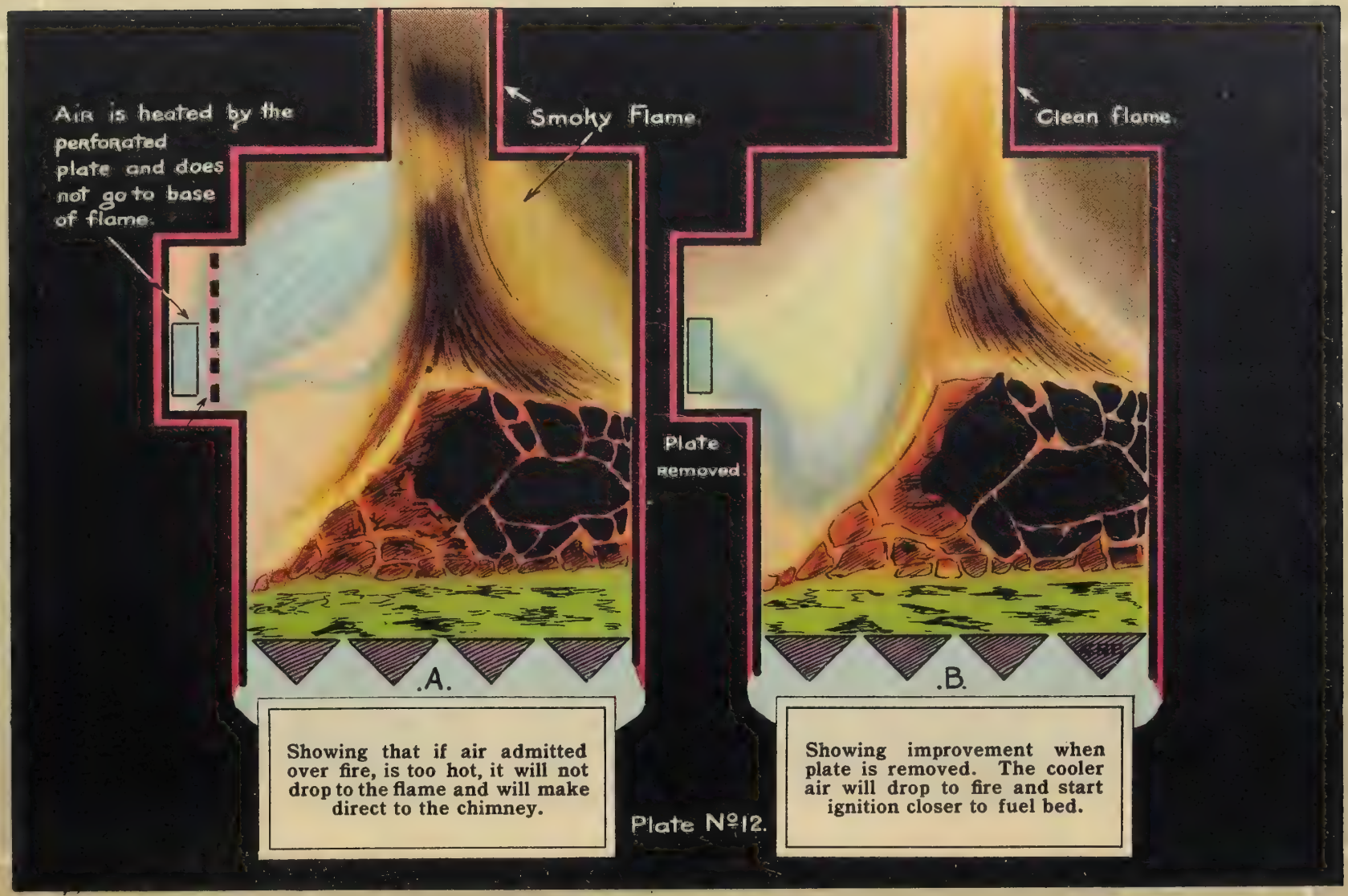

Air is heated by the perforated plate and does not go to base of flame.
Smoky Flame
Clean flame.
Plate removed
.A.
.B.
Showing that if air admitted over fire, is too hot, it will not drop to the flame and will make direct to the chimney.
Showing improvement when plate is removed. The cooler air will drop to fire and start ignition closer to fuel bed.

Plate No 12.

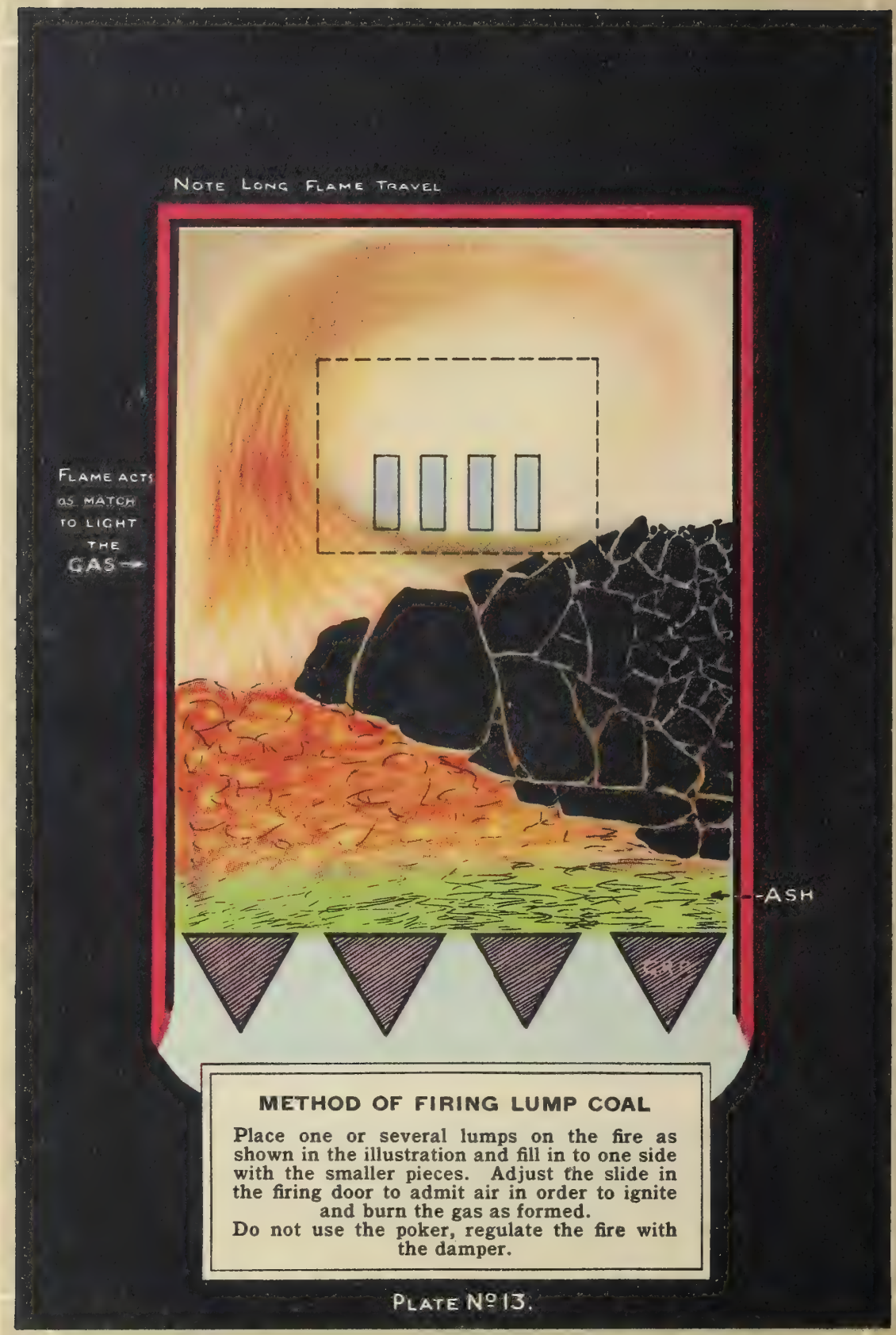
chimney is not as desirable as a brick chimney, especially in a cold climate. The moisture from the burning fuel will condense on to the inside of the metal and build up with soot and tar, reducing its capacity.

Have a chimney large enough in area to give equal satisfaction at the end of the heating season as during the cold weather. If your chimney is small the following happens—you start the season in the fall with a clean chimney which gives service, later during the extremely cold weather, owing to the cold outside temperature the chimney is still of effective size, notwithstanding that if you have been careless in handling the fuel it has deposited soot inside the chimney. As the weather warms up in the Spring the chimney is less effective, due to the thickness of soot that has formed, and frequently the furnace smokes, especially as the fire is not kept at one fixed condition but allowed to die out and has to be forced alternately.

The chimney is automatic in its action, the draft being created by the hotter temperature inside as compared with the outside atmosphere, the hotter the gases the lighter they become, therefore, the hotter the gases in the chimney the greater will be the draft. You will thus see that to burn the proper amount of fuel to warm the house you must have a certain fixed temperature to the gases inside the chimney to suit your condition. ALL THE HEAT THAT YOU USE IN MAKING THESE GASES IS THEREFORE A LOSS AS FAR AS HEAT INSIDE THE HOUSE IS CONCERNED. FOR ECONOMY SAKE THE TEMPERATURE OF THE CHIMNEY CASES SHOULD BE AS LOW AS POSSIBLE. ANY LEAKS IN YOUR SMOKE PIPES, CHIMNEY CONNECTIONS OR LOOSELY BUILT BRICK-WORK OF THE CHIMNEY, ALLOWS THE AIR TO LEAK IN AND TO LOWER THE TEMPERATURE OF THE GASES, WHICH MEANS THAT IN ORDER TO PROVIDE THE NECESSARY DRAFT YOU MUST ALLOW MORE HEAT TO FLOW FROM THE FURNACE TO THE CHIMNEY IN ORDER TO HEAT UP THIS AIR LEAKAGE. THUS YOU WILL SEE THAT A BADLY BUILT CHIMNEY AND LEAKY CONNECTIONS ARE FUEL WASTERS.

A well built chimney should have a tile lining, this prevents air leakage, is a safety factor against fire and is much easier to keep clean.

It is preferred that a separate chimney be had for each connection. If this is not possible see that the pipes at higher levels do not obstruct the flow of gas up the chimney.



METHOD OF FIRING LUMP COAL

Place one or several lumps on the fire as shown in the illustration and fill in to one side with the smaller pieces. Adjust the slide in the firing door to admit air in order to ignite and burn the gas as formed.

Do not use the poker, regulate the fire with the damper.

PLATE Nº 13.

Have damper in each connection so that proper regulation can be had to the draft of each. Avoid connecting an open firegrate to the chimney operating the furnace.

See Plate No. 5 showing good chimney and smoke flue.

CHIMNEY CONNECTIONS

Have the chimney connections from your furnace as short as possible and run in a straight line, every elbow is equivalent to not less than an extra 10 ft. of pipe. Have your iron pipes on the large size, one inch of soot inside an eight-inch pipe will reduce its effective size by half. Soot is formed on the inside of the pipe by the cooling effect of the thin pipes condensing the gas and moisture, which in turn attracts the particle of soot. A one-inch covering of asbestos on the outside of the pipes will preven this, and double the life of the pipe. A galvanized pipe is to be preferred to a black pipe.

The smoke pipe connection between the furnace and the chimney should have a shut off damper and also a check damper. The shut off damper should be placed in the pipe on the furnace side of the check damper. The reason for placing the shut off damper in this position is to prevent the gases from leaking into the house through the check damper, should the fire be neglected or the fuel placed on carelessly.

A common butterfly shut off damper is better than an expensive one, it keeps cleaner and does not foul up wth soot.

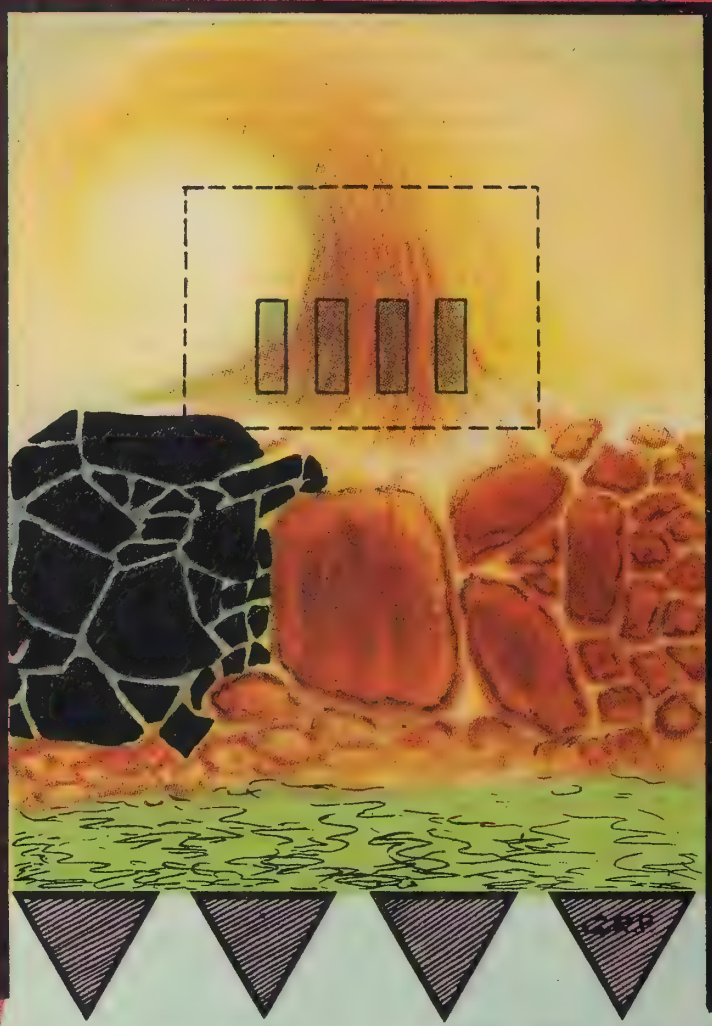
Make full use of the shut off damper, it is not such a fuel waster as the check damper. Unnecessary use of the check damper means that you are cooling off the chimney gases, and are also taking air from the house which you have heated with your fuel This air must be replaced by leakage through the doors and windows.

HOT AIR FURNACES

Before selecting a furnace make yourself familiar with the work that you expect the furnace to do, and how it is to be done. Then make enquiries of the furnace manufacturers and agents as to the operation of their particular furnace and their probable action in doing the work which you require of it.

The following points should be considered:

Do not select a furnace too small. Have one size larger than natural requirements. It is not the size of the firepot, nor the amount of fuel that you put in at one time that regulates the amount of heat which you obtain. It is the air regulation which burns the fuel either slowly or quickly as



Showing second firing of lump coals when made necessary by severe weather.

PLATE Nº 14.

desired. With a firepot too small the user has to give the feeding closer attention, and has to force his fire frequently, which is liable to make clinker troubles.

Do not have too great a slope at the sides of the firepot, otherwise the ash will be inclined to hang on to the sides of the pot and finally form clinker at the center of the fire.

The firepot should be at least twelve inches deep, and made up in two rings. The reason for two rings is that it allows for better expansion of the pot. When made up in one piece, very often the top is hotter than the bottom, or vice versa; which finally results in a cracked fire pot. This has a danger of allowing the furnace gases to leak into the house.

To get the best results from the burning of soft coal, one side of the fire should be in different condition of combustion than the other. This makes it necessary that one side may be shaken down without disturbing the other side. For this reason select a furnace having a grate that can be shaken at either side as desired and having two or more shaker bars.

The combustion chamber should be as large as possible so that it will allow full combustion of the gases as they are driven off the coal. With a small combustion chamber the gases get away before they can be brought up to ignition temperature and once out of the chamber there is no possibility of burning them. See Plate No. 8.

The sides of the radiator should not be confined, but set apart so that it is get-at-able for cleaning. If they are hidden from sight there is great liability that they will be allowed to accumulate soot and so waste fuel, under these conditions proper heating service will not be obtained.

The furnace should be provided with clean out holes placed so that it is not necessary to disconnect the smoke pipes for cleaning.

The ash pit door should have close fit so that air may be closed off entirely if desirable and should have an adjustable slide for regulation of the air supply.

The firing door should be wide enough for a large lump of coal, close fitting and having adjustable slide for the admission of air to the top of the fire.

This adjustable slide should be arranged so that the air will be admitted as low down as possible to the fire, if high up in the door the air is drawn to the chimney without doing the service which was intended of it, or it becomes too hot to drop to the base of the flame. See Plate No. 12. The door

TO BURN THE SMALL SIZES OF THE ALBERTA COALS

This illustration shows the method for putting small size of coal on the fire, Stove or Nut sizes of the free burning and bituminous non-coking coals.

A thickness of ash should be left upon the grate dependent upon weather conditions and the rate of burning required.

See that some hot coal is left on one side and fill in the other side with the small coal.

As the gas is drawn out of the coal it will be ignited and flame will sweep round the combustion chamber.

Very little draft is required under the fire. Air inlet at fire door should be properly regulated to admit air.

Among others the following coals will be found suitable.

Saunders Creek
Alexo
McLeod River
Foothills
Yellowhead
Lethbridge
Kneehill
Dinant
Galt
Taber
Drumheller Field
(See Map)
Carbon
Pembina
Clover Bar

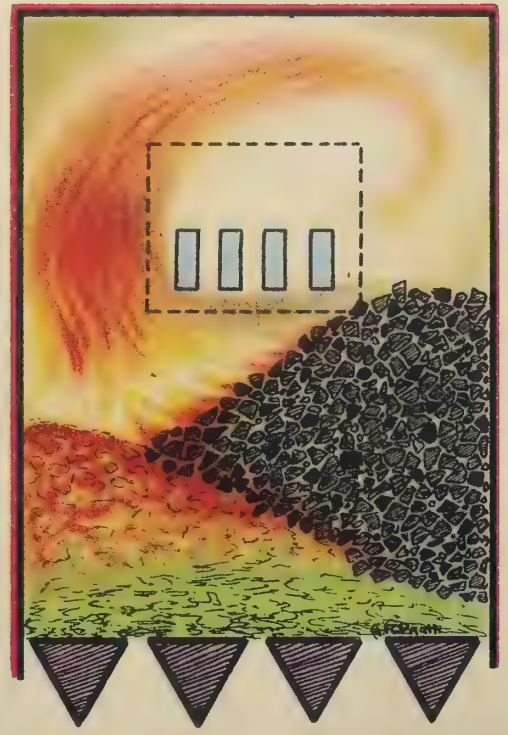


Plate No. 15

should also be provided with sight holes so that condition of flame may be seen without opening the fire door.

A direct damper has no advantage with soft coal and is not necessary. Soft coal very quickly comes to heating condition. If using the direct draft damper it hurries up the fire, but at the same time the heat of the fire is wasted up the chimney. Discarding the direct damper your fire is slightly slower in coming up, but you obtain heat quicker on account of the hot gases being brought into contact with the radiating surface instead of going to waste.

An air connection at the back of the firepot for placing air at the top of the fuel is an advantage when burning soft coal.

The furnace casing should be spaced so that air may be kept in contact with the heating surface as much as possible, and having area to create a large quantity of warm air rather than a small quantity of hot air. The hot air delivery pipes should be large with slope upwards and no sharp bends or corners which would tend to retard the flow of the hot air.

The hot air pipes in partitions should be square or round if possible, even if necessary to make a break in the appearance of the wall. Where the pipes in the partitions are limited to the space between a 2 in. by 4 in. studding they cannot be expected to convey sufficient heat to do the work properly. This often occasions the forcing of the furnace in order to heat one particular room which is hard to heat, and results in the other rooms in the house becoming insufferably hot while doing so.

The cold air supply pipes should have an area equal to, or greater, than the combined area of the discharge pipes. Bends should be easy and pipes should be large, preferably round.

When installing there should be no air leak from the basement into the furnace casing, the cold air pipes, nor the hot air discharge pipes.

Any leaks at these points will cool off the air and prevent circulation. Look upon the heat you supply to the air as being the pump to move the air—the hotter you make it the quicker it will circulate. Don't make it hot in order to make it circulate and then cool it off by mixing it with cold air through leaks which prevents the circulation.

Method of burning low priced mixed coals, Stove or Nut, Free Burning Sub-bituminous and Coking Slack. To 2 shovels full of Sub-bituminous, Sprinkle two third shovel of coking slack. Fire may be made to last any period by increasing or decreasing the quantity of Coking Slack.

Plate No. 16.

You will get better circulation, and heat where you want it by covering the hot air pipes and the furnace casing with asbestos covering, (not asbestos paper,) but covering at least ¾ inch in thickness. It is common practice to wrap the hot air pipes with asbestos paper. By doing so your heat loss is greater than if you left the bright tin pipes bare. Do not leave the pipes uncovered for the reason that you want some heat in the basement. If you must have heat in the basement, leave the covering off the furnace casing.

Select a furnace having ample provision for properly humidifying the air as it passes through the furnace casing, preferably placed so that a large surface of water will be in contact with the air for evaporation, rather than a small surface that requires the water to become hot and steam. Where the water gets too hot the vapor will corrode and rust the furnace parts.

When locating the furnace it should be placed as centrally as possible in the basement, so that good distribution of the hot air pipes can be had. If through circumstances which cannot be avoided, it requires that some one pipe to be carried a long horizontal distance, increase the size of the pipe and cover it with ¾ inch of asbestos covering. It is of no use to increase the size of the pipe without the covering, in such a case any increase in value which you would have due to the larger area will be lost by the increased cooling surface of the larger pipe.

The householder should familiarize himself with the above requirements for a good furnace, so that he may legitimately place a complaint so often made against the fuel, which may really be due to the furnace or the installation.

THE PIPELESS FURNACE

Recently there has been a number of installations of the so called pipeless furnace.

The furnace proper, which is the arrangement for burning the fuel, is usually the same equipment and style as is provided for the pipe installations, the difference being in the air casing. In the usual method of installing a hot air heating system the hot air is distributed to the various rooms to be heated by pipes and the return cold air piped to the bottom of the furnace casing.

With the pipeless furnace the hot air is discharged at some central point in the floor. This hot air naturally spreads

This illustrates the method of making the second firing after the coal as shown on preceding place has become red-hot.

PLATE Nº 17.

itself over the rest of the house dependent upon the layout of the rooms and the door openings. The cold air casing is enclosed around the hot air casing of the furnace, the cold air off the floors of the rooms flow to the central hot air register where it is returned to the furnace through the outer space of the floor register and around the hot air discharge pipe, which is arranged for this purpose, and on down to the base of the furnace casing.

In practice a hot air system having distributing pipes to the various rooms should be more efficient than the pipeless installation, but usually the only consideration given to a distributing system is the price of installation, which results in poor service and an everlasting expense in fuel. This is often wrongly charged to the furnace manufacturers.

To the author the pipeless furnace has been designed as a necessity by the furnace manufacturer in order to protect him against loss of business over which he has no control. With a pipeless installation the whole of the heating efficiency can be controlled by the furnace manufacturer, he is not dependent upon bad workmanship or bad distributing system to condemn his furnace.

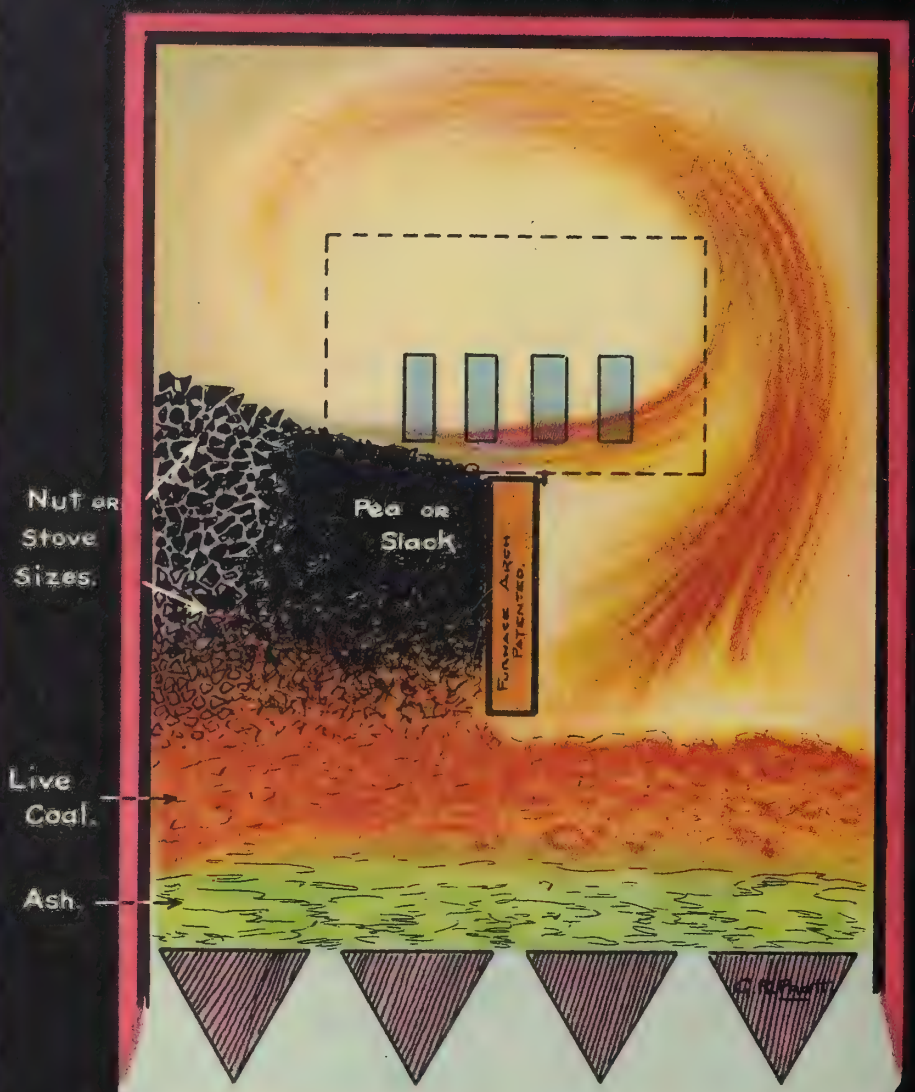
In practice there is less friction and losses from a pipeless installation. Where there is much friction and pipe losses the distributed air must be made very hot in order to overcome this. As a pipeless installation does not have these losses it can distribute a large quantity of warm air which will do better work than a small quantity of very hot air.

It must be borne in mind, however, that the furnace manufacturer does not recommend a pipeless furnace for every design of house. Before deciding upon an installation be certain that the manufacturer will guarantee service with conditions such as you have.

HOT WATER HEATING

The same basic rules may be used for consideration of the hot water or steam heating boiler. The only difference is on the distribution of the heat obtained from the burning of the fuel.

The distributing pipes should be as short horizontally as possible. All horizontal pipes should have a slight fall back to the boiler from the farthest point. See that there is no point where a pocket of air can remain. Figure that in operation you will form a certain amount of air and have the



Showing the division arranged in the fire pot separating the upper part of the fuel bed. One side is filled up with coal and is held by arch; as gas is burned out it is ignited by hot fire under and at other side.

PLATE Nº 18.

pipes arranged so that the air can collect at a point preferably in the radiator where it can be discharged. A pocket of air in a pipe is the same as a closed valve in effect.

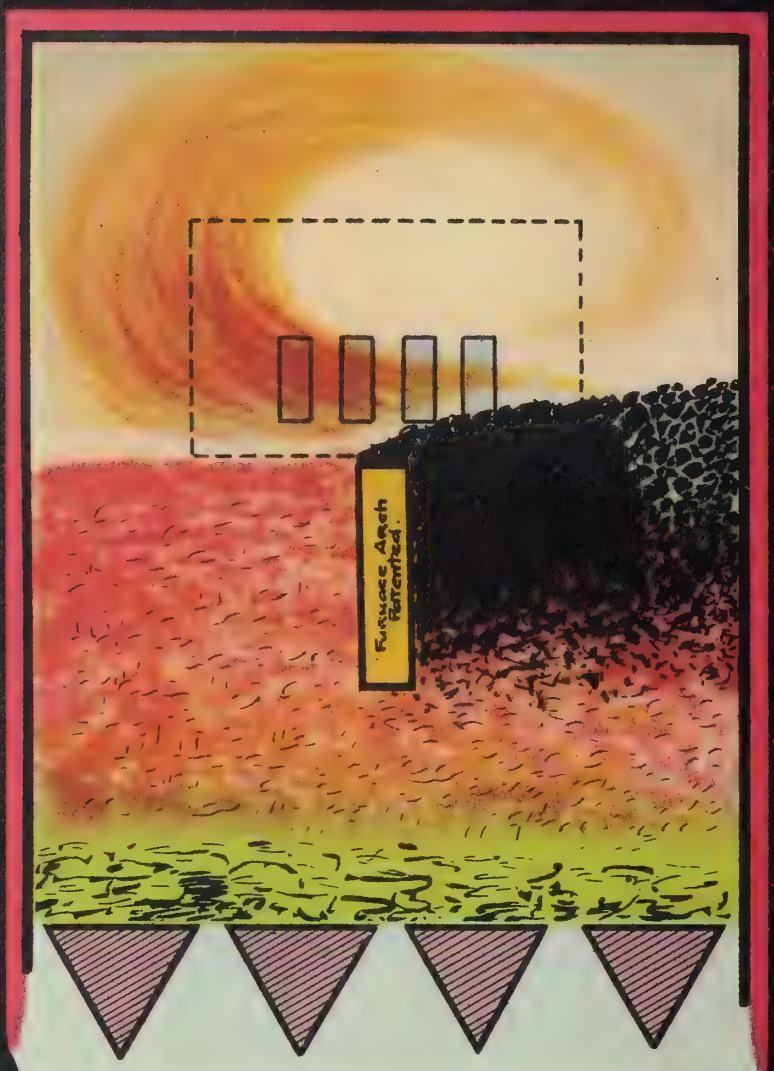
The size of the pipe should be made suitable for the service on the particular pipe, and also must take care of the friction due to its length, and the number of bends. Where this friction will be high the pipe should be increased in size. Do not have some of the pipes larger in size than necessary. If this is the case, improper distribution will result, the larger pipes will be favored, due to the lesser friction, and the hot water will take the line of least resistance, short circuiting through these pipes to the disadvantage of the others. Where such a condition does exist it can be overcome by partially closing the valves on the radiators served by these pipes.

For proper heating service with hot water or steam it is absolutely necessary that the heat be used where intended. To have uncovered hot pipes in the basement destroys this intention. All the hot water discharge pipes in the basement should be covered, as well as the boiler.

Furnaces and boilers should be faced handily to the coal bin so that coal will not be spread all over the basement floor and walked all over the house.

METHOD OF FIRING LUMP COAL

For Bituminous, Sub-bituminous and Lignite, Lump sizes. The best method is alternate firing, from side to side of the firepot, placing one or several lumps in the firepot and filling in to one side with the smaller pieces, see Plate No. 13. Soft coal differs from anthracite in that practically half of its combustible matter is not burned in the fuel bed. The heat of the fuel bed distils out the combustible gas which is passed through the hot bed into the combustion space over the fire. This is to all intents similar to the gas as used in the gas stove. When you turn on the gas on the gas stove you also apply a match to light the gas. You would never turn on the gas and expect it to light itself. The cause of many complaints of explosion and smoke with soft coal is due to this reason, coal is thrown on all over the fire, in other words the fire is smothered, and the gas is expected to light itself. The act of placing the coal on as advised above leaves one portion of the fire which acts as a match to light the gas as it is driven out of the coal.



Showing second period of firing with the Arch after one side has been burned to a red coke.

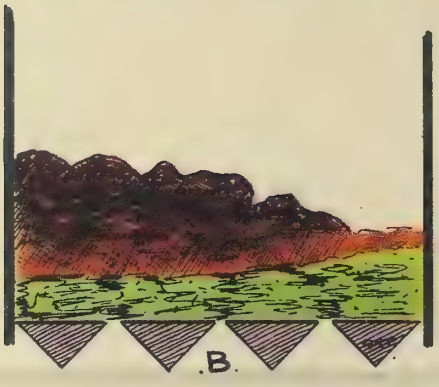
PLATE Nº 19.

Second, you know that if you stopped the air supply to the gas of the gas stove, that the gas would refuse to light and that all the matches that you might try would also refuse to burn. Without supply of air to mix with the gases as driven out of the coal,the gas will not burn and the portion which you have left to act as a match will also die out, see Plates No. 9 and 11 which will show this condition. Therefore, it must be understood that air must be supplied in order to burn the gas at the top of the fire. This is accomplished through the holes provided in the firing door. The regulation of the size of these holes is entirely dependent upon the draft available, and being different for every furnace it must be determined by experiment and the observation of the changes which take place in the condition of the flame when adjusting these obenings.

The rate of the burning of the coal is entirely dependent upon the draft admitted under the fire through the ash pit door. The amount of draft required is dependent upon the free burning qualities of the coal. It seems to be a law which applies to Western Soft Coals that the higher the mositure content the freer burning they are. This does not mean that the high moisture assists them to ignite, but it seems to be characteristic of the fuels. Do not have it thought that a slow burning coal can be made free burning by throwing water on with it, but the inherent moisture content of the coal is an indication of the probable draft which will be required. It will be found with the free burning coal that the draft cannot be entirely regulated by the dampers to obtain proper control. If regulated to limit the burning of the fuel on a clean grate, gas and smoke will leak into the house or the fire will puff out, due to intermittent flow of air and a slight pressure created in the combustion chambers by the burning of the fuel on the fuel bed. With a condition such as this it is impossible to obtain continual even flow of air over the fire through the fire door. For this reason it is necessary to let the ash build up on the grate to act similar to a damper and assist in regulating the rate of burning of the coal in the fuel bed. The thickness of this ash bed will depend upon the free burning qualities of the fuel. This thickness may be estimated by its moisture content and tried along these lines.

Another reason for placing the coal on as shown in the illustration instead of over the whole of the fire is that better control and lasting qualities can be obtained. When you have an even thickness of fire over the whole of the grate the

TO BURN COKING COALS



STARTING — Shake the fire down until there is a thin layer of ash on the grate as in A. Level the hot coals over the whole of the grate, then fill in with new coal, leaving a small space at one side to light the gases. See Fig.

After a time you will find that most of the gas has been burned out and that the pieces of coal have been caked into a mass as in B.

Take a POKER and break up this cake so that air may pass through; then fill in the opposite side with new coal as shown in C.

The ashes may be shaken down at this time if a hot fire is required.

Suitable coals are:

CADOMIN, CROWS NEST FIELD, and MOUNTAIN PARK

As these coals are short flame coals they may be used to advantage in HOT WATER and STEAM BOILERS, but economy can only be obtained by their use if properly handled as above.

whole of the fire is in the same condition of combustion. It would be necessary to force it in order to get it fully lighted and when properly lighted you would have an intense fire for a short time which would gradually die down and necessitate going over the same operation again.

When firing the coal, as shown in illustrations, the face of the fuel at the low side is at its maximum intensity, and due to the less friction through the fire at this part most of the air passes through there. The rest of the new coal is heated slowly and combustion moves horizontally across the fire rather than verticaly up through the whole fuel bed. This provides a more even heating condition. When the fuel is burned to a coke more fuel may be thrown in on the side previously left uncovered, as shown by Plate No. 14.

The method of firing to one side also automatically acts to lengthen out the flame, keeping the unburned gas in contact with the heat, so overcoming the objection of the usual low combustion chamber.

SMALL SIZES OF COALS

The previous paragraphs referred to the method for bu n-ing lump coals. This same method of putting in the coal should be used in burning the smaller sizes such as stove or nut, but as it is more trouble to build up to the same height as with lump (due to its liability to flow or roll down) it is necessary to make two "BITES" at the job.

The Plate No. 15 will show the method of handling.

It should be noted here that a greater use of the smaller sizes of coals would be of profit to the consumer, and would tend to lower the cost of producing all grades of coal. If proper care and attention is given in placing it in the furnace equal results will be obtained as with the larger sizes.

It is not good policy for a user to jump from anthracite directly to the smaller sizes of soft coals, He would be inclined to use the same methods as he had been used to with the anthracite, and the coal would burn away too quickly. The best method is to start out with lump coal and to work out the best method of burning the smaller sizes with the breakage from the lump coal. A considerable saving can be made by using these coals if you are prepared to use a little extra attention in handling.

MIXED COAL

Following the experience that the user would get with the previously mentioned small coal, would be a test of mixed

TO OBTAIN HEAT QUICKLY

Don't do this, it takes time to make coal hot. When it is hot it will be beyond control

Do this—Sprinkle small pieces on hot cinders. Open draft. When house is hot build fire as Plate 13

Plate No 21.

coals, see Plate No. 16. While it may not be a good policy to recommend to a user that he put in two separate kinds of coal it is becoming common practice for the users by "listening in" to various friends, etc., to burn two different fuels, such as coke and pea hard coal, or coke and bituminous slack, or free burning coal and bituminous slack. When a user has done this of his own volition there is profit in trying out the following:

Take any sub-bituminous coal of nut or stove sizes and about one-third of coking slack, (steam coal.) For every two shovels of the sub-bituminous coal thrown in, sprinkle it with two-thirds of a shovel full of the coking slack.

As is known, when burning stove or nut sizes of the sub-bituminous coal alone, it requires that careful attention be given to the draft, otherwise the coal will be burned away too quickly and will cause the complaint of not lasting.

It is also known that if attempting to burn the slack steam coals in the domestic furnace it requires much attention in building up a fire, otherwise the coal cokes in layers and either dies out or else does not give the heating service that the user expects of it.

With the first mentioned free burning coals you must choke it down to make it last, and with the second, coking slack you must open up the draft to make it burn.

With the two coals used together as suggested each acts to counteract the objections of the other. The free burning sub-bituminous coal acts as a poker to bore holes in the coking slack and to keep it open; while the coking slack envelopes the free burning coal and prevents it from burning away quickly. Fires built in the way shown on Plate No. 16 will last for long periods without any attention whatever except by control of draft. It may be regulated down by the damper so that it will remain for days without going out, and is at all times during this period in condition to be started up to a hot fire merely by opening up the damper.

The system is practically smokeless and does not require a great deal of care in building up. The slack helps to hold the coal in position when building a fire better than does the nut and stove sizes alone, as it does not run so freely.

To a user who wishes to take advantage of all the economy possible this fuel is to be preferred. Any of the Alberta sub-

Plate No. 22

TO USE ALBERTA SOFT COALS IN THE QUEBEC HEATER

Have a small quantity of ashes on the grate.

Before making up fire see that you have about 4 inches of red coal at the bottom of the heater. Open up draft at A so that this coal will be burning well. Then take one or several lumps and place in the pot as shown in sketch, closing off draft at A before doing so, and opening the air inlet over the fire at B.

When the gas is well lighted, which may be about 15 minutes after putting in lumps of coal, the draft A may be opened up again for a short time if wishing to force the fire, but usually enough draft will be obtained with A closed. Never entirely close B.

When burning up small pieces, put in one lump and fill in on ONE SIDE ONLY with the smaller coal, having A closed and B open.

If insufficient air is obtained at the start to light the flame through B, leave the firing lid open for a short time.

The following are some of the coals which may be fired in this manner:

Bankhead, Saunders, Alexo, Foothills, McLeod, Galt, Lethbridge, Taber, Drumheller, Kneehill, Carbon, Pembina.

DO NOT USE COKING COAL

You require a check damper and a shut-off damper in the smoke pipe. Check the draft all possible.

bituminous coals are suitable in the stove or nut sizes, but it must be free from slack. While the slack from the Crows Nest Field, Cadomin or Mountain Park are preferable for the steam slack.

When receiving the coals do not shoot them in the same bin together if it can be avoided, it is not easy to get a proper mixture in this manner. Better results are obtained if the user puts the slack in a separate pile and feeds the furnace from the two piles alternately.

At the second period of firing the mixture is put on in the same way as was advised for lump, by filling in the side left open at the previous filling, see Plate No. 17. This, however, is only necessary during excessive cold weather or when the fire has to be left for long periods without attention.

FURNACE ARCH

As a further use for the small sizes from the domestic coals, and showing a further reduction in cost to the user is a furnace having a firebrick division, or Furnace Arch, as Plates No. 18 and 19.

This arrangement consists of a tile supported in the fire-box so that a continuous bed of fire is maintained under the arch, the top edge being kept level with the firing door opening.

When operating on this method, egg size and smaller coals are more economical than the large lump. If using the free burning coal a bed of ashes must be left in the grate, as with the other methods of burning the free burning fuels.

To start, build a fire over the whole of the grate below the bottom of the furnace arch. When this is well lighted fill in the one side with the coal up to the level of the top of the arch or over. The flame will be seen to flow from under the arch, as in Plate 18. After the coal has become partly ignited the flame will change over to the top of the coal. When all this coal is fully ignited and has become red coke the other side may be filled in as shown in Plate 19, and the same operations will take place. The coal may be carried much above the arch if desired to build fire for a long period.

If using nut slack or pea slack best results will be had if the more open coal is put against the sides of the fire pot, putting the slack against the furnace arch.

Excellent results are obtained with the mixed coals, free burning nut and coking slack used in the same proportions as previously described.

Fig. D

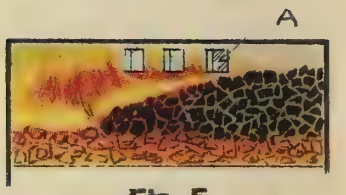


Fig. E

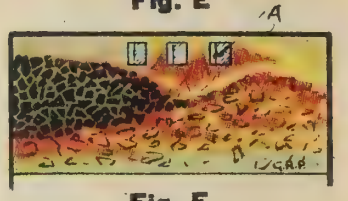


Fig. F

Plate No. 23

TO USE ALBERTA SOFT COAL IN THE KITCHEN RANGE

When lighting a fire with the following coals: "Galt, Lethbridge, Taber, Drumheller, Kneehill, Carbon, Pembina," the quickest way to obtain heat is to clean the grates and cover with about 3 inches of stove size coal. Then build your wood fire on top of the coal.

The wood while burning, will quickly heat the oven and will also light the coals under the wood, giving you a quick fire without smoke.

Keep the slide A open to admit air over the fire, and admit a small amount of air at B. See Fig. D.

When using "Saunders, Alexo, Foothills, McLeod" coals it may be necessary to put a few pieces of coal on top of the wood as well as under.

When your coal is lighted fill in at one end as shown in Fig. E, and regulate the air at A.

If necessary to make up fire again, fill in as shown in Fig. F after the previous filling of coal has become red-hot.

Stove or nut sized coals serve the purpose best, Save the lumps for keeping the fire in over night.

DO NOT USE COKING COAL.

FIRING COKING COALS

If using the bituminous coking coals alone they require different treatment in the furnace to that of the free burning coal and non-coking bituminous.

The coking coal when placed in the firepot may be in small sizes, or it may be in lump, but as soon as the coal becomes heated the pieces may be said to melt and run together.

Melting is the first change which takes place. As the gas is driven out of the coal the fluidity disappears and the remaining coal and coke solidifies into a mass which requires to be broken with a poker. If the coke is not broken it has the same effect as a clinker, preventing the air from passing through the fuel bed, consequently the fire will go out, or become so low that heating results will not be obtained.

The same methods should be used in placing the coal in the fire as with free burning coal, i.e., never smother the fire, but leave one side open to provide the flame to light the gas as it is driven off. As these coals contain less moisture than most of the free burning coals the flame is easily kept ignited.

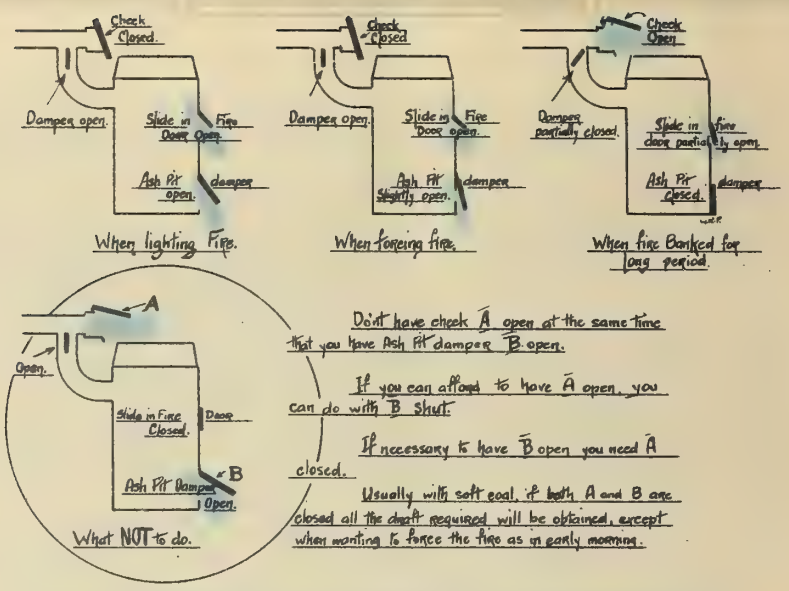
Due to the fact that these coals tend to run and choke off the supply of air through the fuel bed a thick fuel bed should not be built in one operation.

As the coal does not so freely burn as the domestic coals there is no need to retain an ash bed on the grates. A fairly heavy fuel bed of red coke should be built up slowly by placing the fuel in at alternate sides of the firepot and breaking the coke formed before placing on new fuel

Once that a heavy fire has been built up in this manner you have to all intents a bed of hot fuel similar to that obtained from anthracite, and which requires the same methods of handling and damper regulation.

These coals require more draft than the free burning domestic coals. The proper regulation must be found by trial, when this regulation has been decided upon make it a standard method for your furnace. When you find that you cannot get results with that method, check up your operations, you may find that there is a condition at the time which you have overlooked.

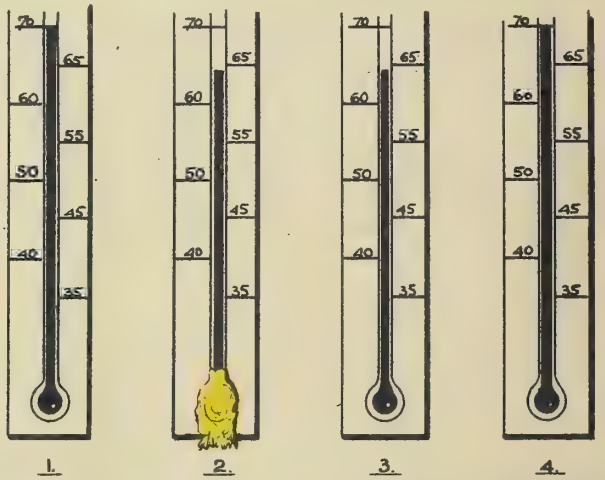
Care should be given to see that the proper amount of air is supplied over the fire, otherwise a heavy deposit of soot will be formed. If the coal is placed in such a manner that a flame is not retained the plates and heating surfaces will build up with pitch and tar.



THE OPERATION OF THE DAMPERS

Plate No. 24

As the skin is moist like the wet bulb of thermometer No. 2 you can see the results of the lack of proper humidity. You will feel cold regardless of the temperature shown on thermometer No. 1.



Thermometer No. 1 shows the temperature of the room as seen by the thermometer. By placing wet flannel on bulb of thermometer No. 2, the actual temperature that you feel will be shown. If you have not the right amount of humidity in the air the thermometer will show reduced temperature while No. 1 will remain the same.

With the proper amount of humidity thermometer No. 3 will show equal heating comfort to what you would have without the humidity as shown by thermometer No. 4, and more healthy conditions.

PROPER HUMIDITY WILL SAVE FUEL

Plate No. 25

Both of these conditions are wasteful in fuel and if the user allows them to continue he will not get heating results.

HURRYING UP THE FIRE WITH ANY COAL

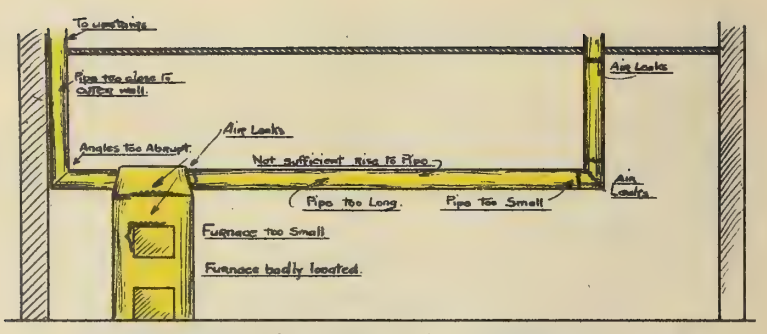
A complaint very often made by the user is that when the fire is forced and becomes hot it is beyond control and continues to boil the house out until it dies down, and that the heat is not lasting.

Very often the user will allow the fire to become low and suddenly discover that the house is cold, or he wants heat quickly the first thing in the morning. He will go down to the furnace, open up the drafts wide and throw in a lot of coal and expect heat. He will have to wait until the coal becomes hot before any great amount of heat can be expected. When it does become hot it will be past control and an intense fire will be maintained until most of the coal is burned away.

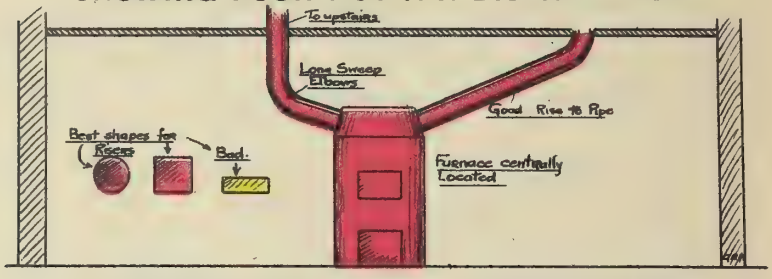
The proper method to use in a case like this is to open up the drafts and sprinkle in a small amount of coal, see Plate No. 21. This would make sufficient heat to warm up the house. When the house is warm, then would be the time to put in a lot of coal in the proper manner and to check off the draft and ash pit damper.

Don't leave it to the last to open up the drafts, nor stand and watch it while it hurries up, or you will have the result that is shown here.

You cannot hurry the furnace when you are going out any more than you can hurry your wife. There are certain operations which have to be performed in the proper order, otherwise you will have trouble.



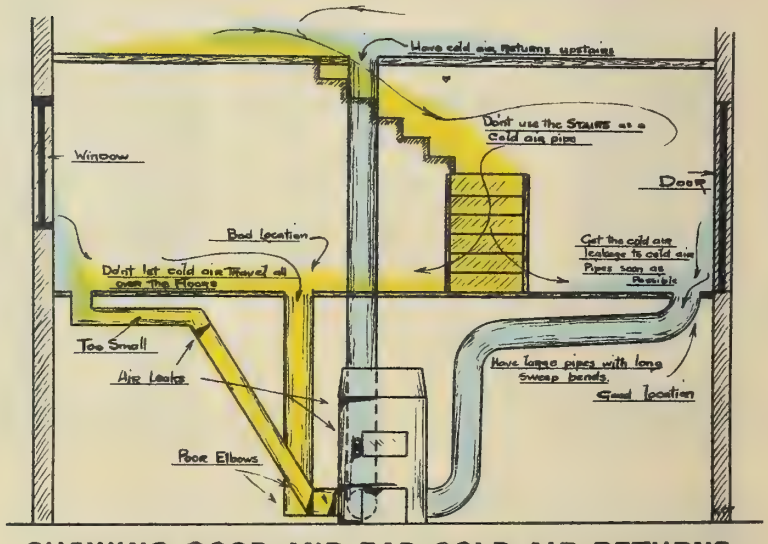
SHOWING POOR HOT AIR DISTRIBUTION



SHOWING GOOD HOT AIR DISTRIBUTION

Plate No. 26

A Good Installation Means Economy in Fuel



SHOWING GOOD AND BAD COLD AIR RETURNS

Plate No. 27

Good Cold Air Distribution Means Heating Comfort

THE QUEBEC HEATER AND STOVES

Unless the user has had experience with the soft coals and knows how to handle them in this class of heater he should burn lump coal, never putting on too many lumps at one time. Until the coal has become fully ignited the draft should be closed off tight under the fire, keeping the air check open in the firing door. If the fire was low before putting in the coal the cover at the top should be left partly open. This will allow the flame to ignite and prevent any danger of explosion.

When a flame stays on top of the coal without going out, the draft may be opened up under the fire for a short time if necessary, but the air check inlet above the fire should be left open at all times, reducing the opening slightly when the fire is in good condition.

The smaller sizes of coals require that they be put on in small quantities at a time, otherwise they will smother the fire and prevent ignition of the gases, which are liable to puff into the house. See Plate No. 22 for method of placing coal.

KITCHEN RANGES

For cooking, the stove and nut sizes of the domestic coals serve the purpose best.

When lighting up the fire in a cold stove, spread about 2 inches of raw coal upon the whole of the grate, having first shaken out the ashes, build your wood fire on top of this. The result will be that the burning wood soon heats up the oven and also ignites the coal under the wood. When the coal is well alight then place more coal at one end of the grate, reversing the operation when that is well alight.

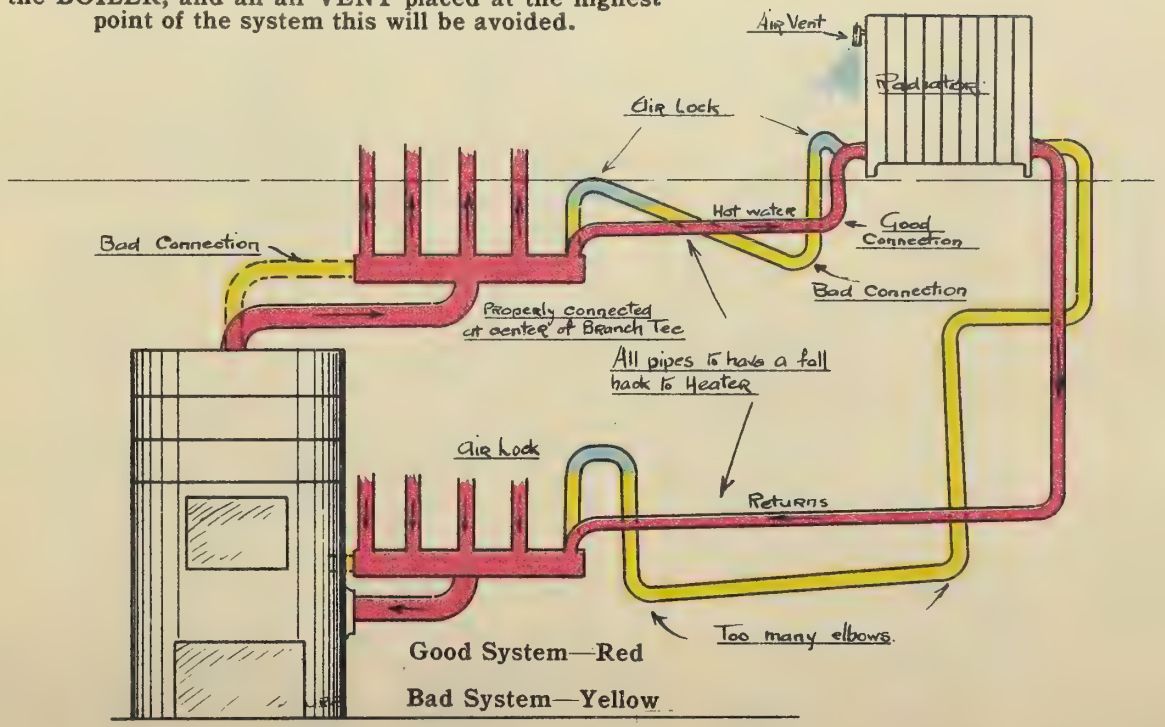
When cooking it may be necessary to keep the grate shaken free from ashes and to have the draft open under the fire, but at other times the ashes should be allowed to build up to about 2 inches and the draft closed off, keeping a small amount of air flowing in on top of the coal so that full benefit may be had of the burning gases.

To hold the fire in over night or when the range is not required for cooking, a lump may be placed in the center. This will burn slowly, but lump will not give you service for cooking unless it is broken up in the fire. This latter is not good policy as it is conducive to making clinkers. See Plate No. 23.

MAGAZINE HEATERS

For magazine fed heaters and boilers such as the "Spencer," the Pembina coals and some of the upper seam

An AIR LOCK in the pipes has the same effect as a closed VALVE. If all pipes are given a fall back to the BOILER, and an air VENT placed at the highest point of the system this will be avoided.



GOOD AND BADLY DESIGNED HOT WATER HEATING SYSTEM

Plate No. 28

Drumhellers such as Newcastle and Western Gem have been very satisfactory, but it must be understood that the preparation of the coals is a great factor, nut pea size being the most suitable.

If too large a size is used the coal will not flow,and as the air spaces between the larger pieces is great, economy and service cannot be obtained. By the addition of the pea size it helps to fill up the voids between the larger pieces of coal.

The coal must be free from slack and dust, otherwise it will not flow and will also form clinkers.

The instructions which are issued with these heaters are based entirely upon anthracite. Before service can be had on the soft coals you must apply the same rule as has been urged for the ordinary domestic furnace (that less draft is required than for anthracite). The automatic dampers must be readjusted, so that less air will be admitted under the fire. It is also necessary that the holes in the fire doors be left open if this is not sufficient unhook the fire door.

The magazine door should not be closed tight, but should be wedged open with a match. This tends to draw a current of air through the hopper, preventing the formation of gas, this also provides more necessary air to the top of the fire.

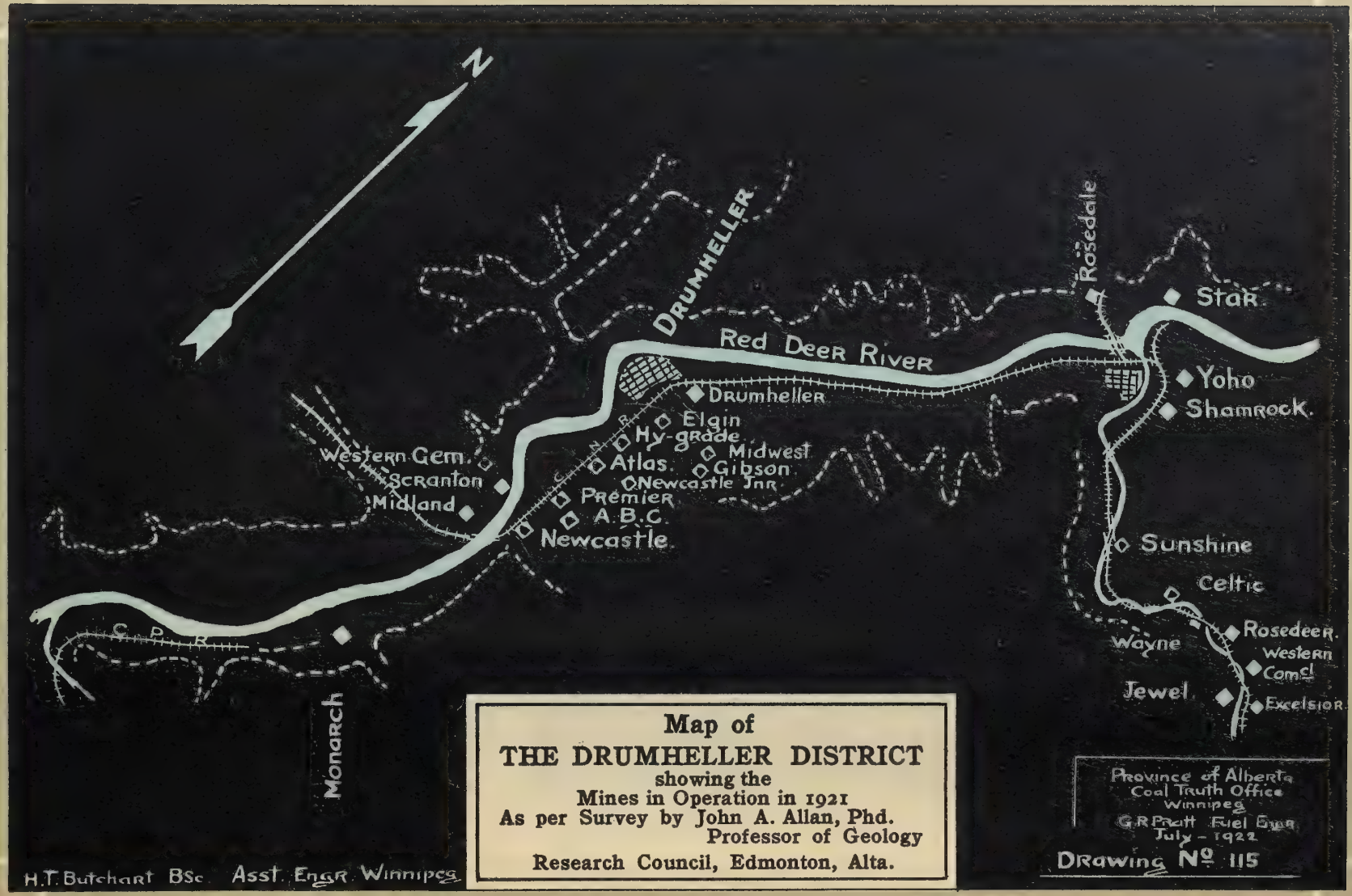
When buying coal for this purpose make sure that the dealer knows what it is required for and that he is satisfied that the preparation and sizing is correct.

As experiments are made it is probable that other Alberta coals will be found suitable; this can be found out later by inquiry.

HUMIDITY

One of the requirements for healthy heating conditions is humidity. Air will hold a certain fixed weight of water according to the temperature of the air. The higher the temperature of the air the greater the amount of moisture which it will hold. If a volume of air at a certain temperature contains all the moisture which is a fixed quantity for that temperature, it is called saturated. If the temperature of the air which is saturated is reduced, the moisture in excess of that for saturation at the lower temperature will be excluded, showing up as dew, or as you will better understand, as rain.

At 30 below zero 1 cubic foot of air at saturation point contains slightly less than one-tenth of a grain of water. At 65 degrees above zero, which is the proper heating temperature of the house, 1 cubic foot of saturated air contains seven and three quarter grains of water. In each case air


N
Drumheller
Rosedale
Star
Red Deer River
Drumheller
Yoho
Shamrock
Elgin
Hy-grade
Midwest
Atlas
Gibson
Newcastle Jnr
Premier
A.B.C.
Newcastle
Western Gem
Scranton
Midland
Sunshine
Celtic
C. P. R.
Wayne
Rosedeer
Western Coms!
Jewel
Excelsior
Monarch
Map of
THE DRUMHELLER DISTRICT
showing the
Mines in Operation in 1921
As per Survey by John A. Allan, Phd.
Professor of Geology
Research Council, Edmonton, Alta.
Province of Alberta
Coal Truth Office
Winnipeg
G.R.Pratt Fuel Engr
July - 1922
Drawing No. 115
H.T. Butchart BSc Asst. Engr. Winnipeg

containing these quantities of water is called 100 per cent humidity at the given temperature.

During the winter months fresh air must of necessity be obtained from outside. This enters the house at less than the saturation point, therefore when the new air is heated to the temperature of the house its percentage of humidity must naturally be very low. In the case above the incoming air when heated would be considerably less than 1 per cent humidity.

With such a low percentage of humidity it will be easy for you to realize that as the air comes in contact with the moist skin of the body or the throat, that there is a very quick evaporation from the surfaces, the result being that there is a feeling of coldness. This drying up effect also causes throat and lung troubles.

The remedy is, to see that the water pan of the heating equipment is kept properly filled, also if possible, keep vessels of water on the kitchen stove.

With the proper humidity it is probable that you will feel warm at say 65 degrees, while you would feel cold at 70 with very low humidity. The temperature that you feel is not the temperature that the thermometer shows in the room, but it is the temperature which the moist skin attains through the evaporation of the moisture off the surface.

The method of cooling water which is used in hot climates where ice cannot be obtained is an illustration of this. It being usual to keep drinking water in a bag made of skin, the water oozing through allows the outside to remain moist. The bag is usually hung in an air current. This air although warm, by evaporating the moisture off the outside of the bag cools the water much below the room temperature. The temperature to which it is lowered depends upon the humidity of the air in the room.

CLEANING FIRES

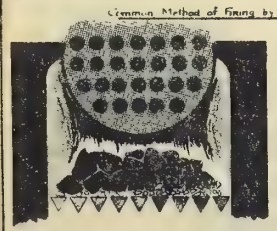
Of equal importance to the method which you use in placing the coal on the fire is the method used in cleaning the fire. This work improperly done will destroy the results which you would expect from the good work you did when putting in the fuel.

In describing the methods of firing the coals, it was recommended that a thickness of ash be left on top of the grate, the thickness to depend upon the kind of coal being burned. It should be fully understood that clinkers will not serve this purpose. When you have formed a clinker, get rid of it.

COAL TRUTHS FOR OWNER AND FIREMAN. No. 1

Common Method of Firing by Inexperienced Fireman.

Hand Firing N° 11



Comparison of Results
Soot and Smoke

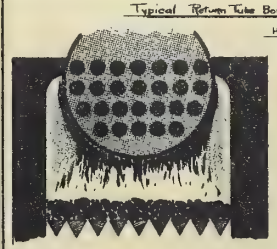
Coal PILED HIGH in the centre of the Fire. Sides BARE and Air Leaking through gaps.
LUMPS or Coal too large for good combustion. Wastage through gaps and Air LEAKAGE. The Lumps burn clear and causes losses due to uneven air between lumps.
Coal too close to the Boiler Shell for PERFECT COMBUSTION. Gases UNBURNED with SOOT and smoke. TUBES FOULED with soot.
Probable wastage of Fuel 50 per cent.

A

Drawing N° 85

Typical Return Tube Boiler Setting

Hand Firing N° 10



Comparison of Results
Soot and Smoke

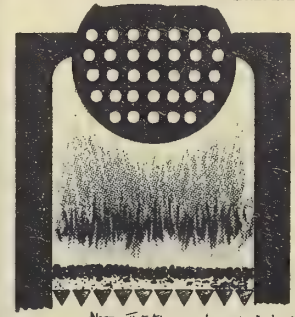
Showing even firing with a low setting.
The gases are cooled off by contact with the relatively cool boiler shell before they became hot enough to be ignited. Causing SMOKE and SOOT. Even any heating service it requires constant attention of the fireman. YET – This is usual practice and fireman are often given other work which takes them away from the Fire for Hours.
The BEST FIREMAN in the world cannot help but WASTE FUEL with a condition such as above. It also requires the best grades of coal to obtain an average.

B

Drawing N°

Showing Furnace Setting for GOOD COMBUSTION

Coal Feeds N°



Heat without Smoke or Soot

By keeping the gases as dwell off the coal in the furnace in contact with the fires long enough to become heated & ignition temperature, economy in fuel is obtained, with increased boiler capacity and WITHOUT Smoke nor Soot.

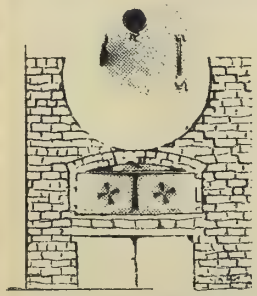
NOTE – That tubes are clean and will absorb the Heat.

C

Drawing N° 37

— Is Your Boiler in the condition? —

Coal Trade N°



Every hole in the Brickwork means so many pounds of coal wasted and so many more Troubles manufacturing stoking conditions.

The more Troubles you have to stoke the greater the waste will be.

The more draught you put on the gauges will be the result is that if the brickwork is in this condition.

Keep the furnace doors in good repair you should not close doubtful with greater confidence if the steam keep.

Are your gauges properly lighted so that you may see what you have got without guessing?

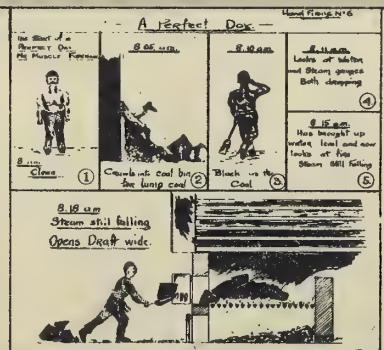
— How Long will you keep it in this Condition? —

D

Drawing N° 39

A Perfect Day

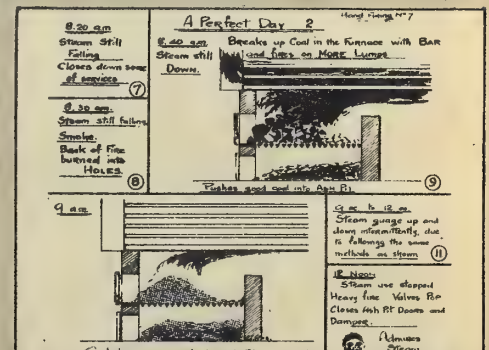
Hand Firing N° 6



Drawing N° 40

Hand Firing N° 7

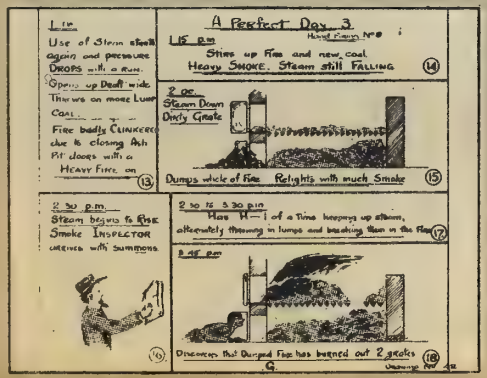
A Perfect Day 2



F

A Perfect Day 3

Hand Firing N°



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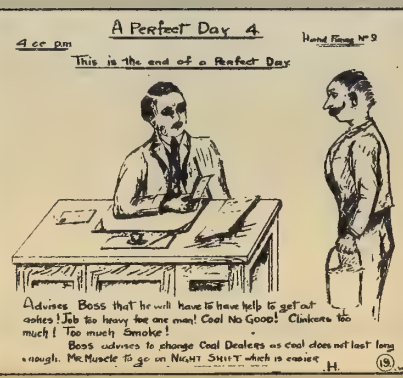
Drawing N°

A Perfect Day 4

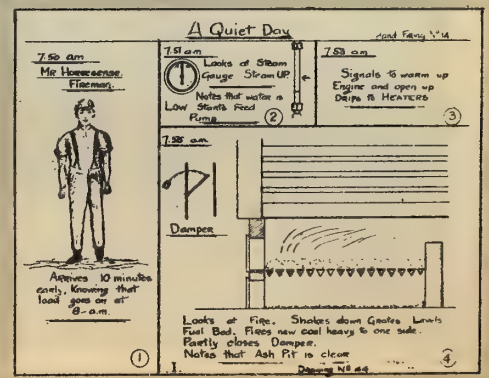
Hand Firing N° 9



H

A Quiet Day

Hand Firing N° 4



I

Drawing N° 44

If it is left it will prevent the air from flowing through the fire, the result being that all the ash will melt into clinker, building up a mass of clinker which will necessitate destroying the fire in order to get it out.

All ash, if made hot enough, will melt to clinker. With a grate kept in proper condition the air flowing through, cools off the ash before it reaches melting point.

When shaking your grates. Don't think that you are cranking a Ford Car, do as Mutt advises "Use discretion," otherwise you will waste fuel in the ash pit and destroy the condition of your fire.

Do not shake the grates too freely. Usually a bent poker, see Plate No. 6 will serve the purpose better than shaking, paying particular attention to the sides of the firepot. Ash will tend to hang up on the sides of the pot. With such there is a tendency for all the air to pass through the center of the fire, this will very often start a clinker. The ash also prevents the pot, from becoming hot and doing the work expected of it. You will find that if you keep the sides free that the center of the grate will take care of itself.

Keep the ash pit free of ashes. If you allow the ashes to build up or hot fuel to remain under the grates, you will burn out the grates. You cannot burn out the grates with the fire you have on top of the grates, no matter what fuel you are using or how hot your fire is. The more you are forcing the fire the more air you are supplying to cool the grates, providing that there are no ashes piled up to the underside of the grates.

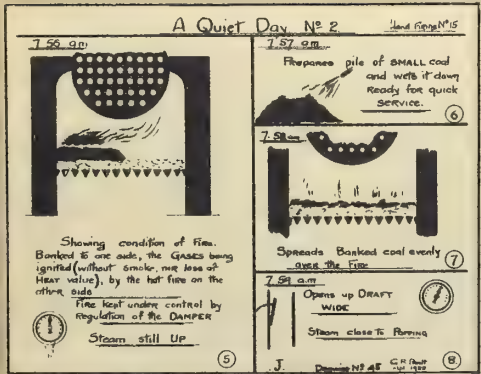
The remark is often heard that a certain coal has burned the firepot. There are two methods of burning a firepot. The first method is to use it for about 15 years, by this time it has done its work properly and is due for renewal. The second method is best explained by describing the method by which you can do it.

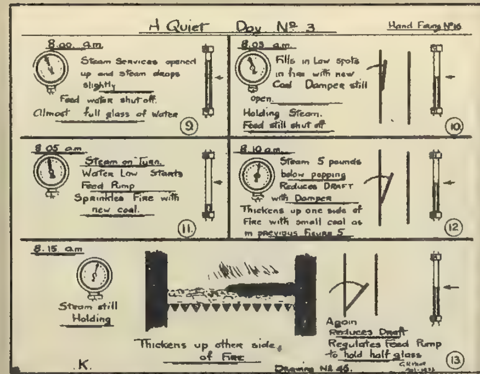
Make a hot fire with a thick bed of fuel, then close all your hot air registers, or close them all but one or two in some room which you wish to make particularly warm. Or leave all the hot air registers open and cover the cold air return registers in floor with carpets.

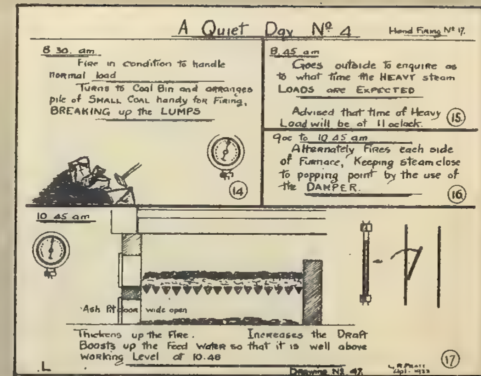
Do this and it will box up the heat in the furnace and prevent the circulation of air round the firepot. Try this a few times and you will finally succeed in breaking the pot.

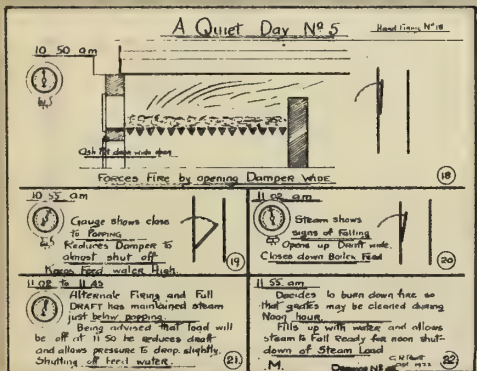
If you don't wish to do this see that you do not have a condition such as above.

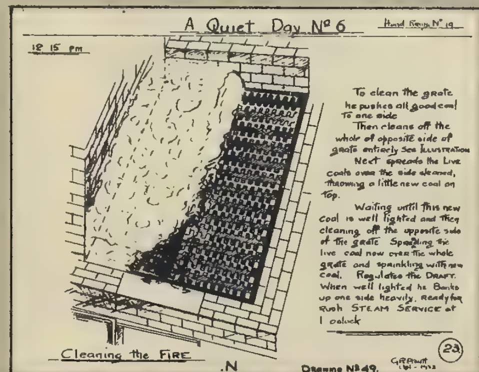
COAL TRUTHS FOR OWNER AND FIREMAN. No. 2

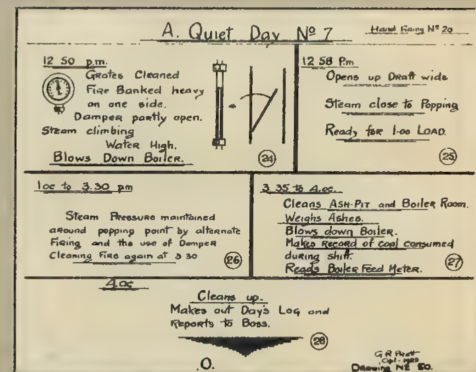


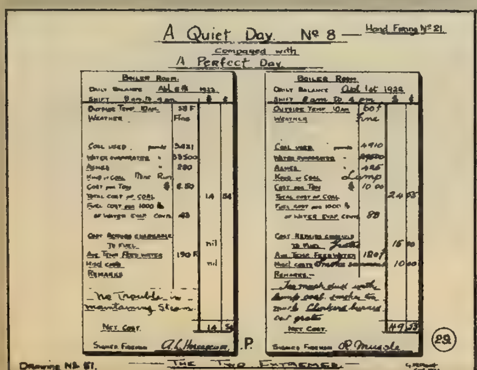


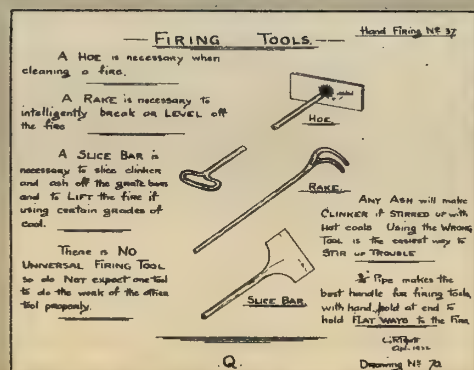


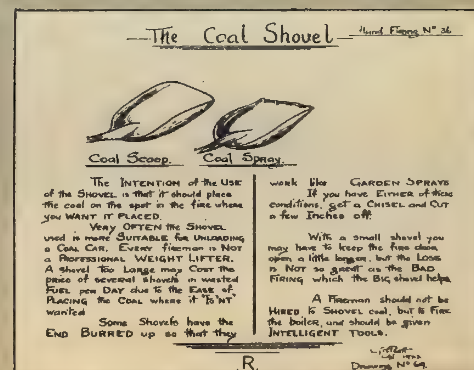












THINGS TO REMEMBER

That it is not the amount of coal which you put into the furnace at any one time which regulates the heat. It is the air regulation which governs the rate at which the coal burns, and which controls the heat you obtain.

That you cannot know what the condition of your fire is by sitting upstairs and pulling the chains attached to the furnace door and the damper.

If you cannot get the service which you think you should get, don't blame the coal nor the furnace. There are thousands getting the service required by the use of the same coal. Neither have you the only furnace of that particular make. When you are up against it get advice.

Before working around the furnace and stove pipes (*or your car*) rub into the nails and hands a small amount of shaving cream moistened with glycerine. This will save you much trouble later in cleaning the hands.

If you think that you have a real kick against the coal, give the dealer a chance to rectify it before condemning him to some other region.

Don't switch from one dealer to another unless you cannot get service; a dealer will naturally give better service to his regular customers.

YOUR HOUSE CONSTRUCTION

As can be expected the structure and materials used in the construction of a house have considerable effect upon the resultant heating conditions obtained.

A stone basement is warmer than concrete for the reason that stone as laid has joints which make a break in the continuity of the material. Each break tends to reduce the transfer of the heat losses.

It is the practice to build concrete basement walls thinner than what would apply to stone.

COAL TRUTHS FOR OWNER AND FIREMAN. No. 3

FURNACE BRICKWORK

Hand Firing No. 25

Fig 1

The BEST BOND for FURNACE BRICKWORK is as fig 1 often called FLEMISH BOND Although headers and stretchers.

When FIRST LIGHTING up a NEW FURNACE, DRY out the BRICKWORK with a SLOW fire for a week if possible.

After furnace is HOT it will be found that EXPANSION has OPENED up JOINTS in places, MORE or LESS depending upon the WARMING up you have given it.

Figure 1 bond will NOT PREVENT this Expansion, but it will LOCALIZE the CRACKS where they can be filled in and not SHATTER the whole of the BRICKWORK as very often applies with bond such as Figure 2, which is the usual method of building FURNACE work

LEAK ins, which is expensive. After the boilers has been in service for SEVERAL WEEKS, CAULK in the JOINTS with ASBESTOS STRING and PLASTER the whole of outside SURFACE with PLASTIC CEMENT (similar to J.M. ASBESTILE.)

When LAYING FIREBRICK they should be DIPPED in a THIN mixture of FIRECLAY. (NOT TROWELLED) placed practically BRICK to BRICK. If the joints are TOO THICK the fine clay runs out like sand and the brick LOOSENS.

The BEST firebrick OBTAINABLE is the CHEAPEST for the HOTTEST part of FURNACE and should be PLASTERED with HIGH TEMPERATURE CEMENT.

Fig 2

ALL BRICKS are PAROUS and

Heavy lines show Expansion Cracks.

Drawing No. 68

S.

DRAFT.

Hand Firing No. 29.

Draft is not the amount of GAS that You pull through the Flue but the ENERGY that does the work.

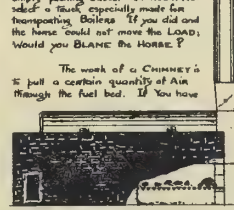
If you had at your disposal ONE HORSE for work and you were transporting a bulky material such as empty packing cases. You would NOT select a TRUCK especially made for transporting Boilers. If you did and the horse could not move the LOAD, Would you BLAME the HORSE?

The work of a CHIMNEY is to pull a certain quantity of AIR through the fuel bed. If You have a certain LOAD on the BOILER and you appease & have all the draft available and you cannot HAUL the LOAD. DO NOT put on more coal and make it harder for your "HORSE" to pull the air through the thicker fuel-bed.

"LET THE FIRE BURN DOWN THIN"

Because your DRAFT GAUGE shows a HIGH DRAFT it is not to say that the CHIMNEY is doing maximum WORK. If your grate was BLOCKED with CLINKER it would STILL show a HIGH DRAFT! A PACKED FIRE has the same effect as the Clinker.

If you cannot get sufficient draft, check over the brickwork it may be in the condition shown here, as your fires may be full of holes, and leaking air through the bad. A CHIMNEY is put in for a certain purpose and that it serves this purpose and no other.



How much does it cost per DAY to keep the BRICKWORK in this condition? How many days COSTS to REPAIR?

Drawing No. 28

T.

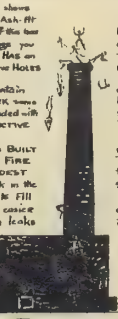
DRAFT. 2.

Hand Firing No. 30

If your Draft gauge shows no DRAFT Try CLEANING the ASH-PIT doors for a few seconds. If this has no effect on the DRAFT gauge you have leaky brickwork. If it HAS an effect on the gauge you have HOLES in the FLUES

A chimney has a certain FIXED CAPACITY for WORK same as a HORSE when it is loaded with JUNK it cannot do PRODUCTIVE WORK.

THE CHIMNEY was BUILT to PULL AIR THROUGH the FIRE and is PULLING its HARDEST ALL the time, every leak in the setting or chimney helps to FILL the chimney. It is much easier for it to pull air through leaks than through the fires.



The chimney should do the work it was intended for, and NO MORE. It also Requires a CHECK REIN in the form of the DAMPER to see that it does not do too much work.

The DAMPER has the same effect as the cover on the OATS has on the HORSE. If the horse was left FREE to eat the OATS he would soon eat up his EARNINGS

The GREATEST FUEL LOSS is caused by having too much AIR. Try closing down the dampers some time when you cannot keep up steam.

If you have been able to keep up steam at some previous time it is not lack of DRAFT capacity but is your TROUBLE but your chimney is evidently overworked with JOBS before starting on its job which it was intended for.

SPEND a PROFITABLE DAY PLAYING with DAMPER

KEEP out the DUST.

U.

Drawing No. 61.

DRAFT GAUGES.

Hand Firing No. 20

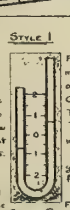
The Draft gauge is beginning to be recognised as being a NECESSARY part of Boiler Fittings

There are instances where proper regulation of draft will save 50% of fuel. In the AVERAGE small plant 10 to 25% of fuel could be saved by better knowledge of DRAFT CONDITIONS

It is POSSIBLE to save the expense of a STEAM GAUGE used to OPERATE a boiler without one. If you were prepossed from the trouble that it would entail and the BAD SERVICE that would go with it.

When you have equipped your furnaces with draft gauges and the firemen have fully gotten on to the use of them they will be equally as impatient as the Steam gauge

STYLE 1



STYLE 2

The best Type of draft gauge is as Style 1 The VISIBLE MOVEMENT of the RED LINE is much greater than in the under cap U Tube as Style 2

The Draft gauge tells the FIREMAN — What LOAD he can obtain in EMERGENCY! What load he has on at the TIME! Whether his GRATES are CLINKERED or NOT! That he has HOLES in the fires! That the boiler setting is leaky and in need of repair!

(That he is getting an NOT getting the BEST ECONOMICAL results from the fuel that he is burning.)

The OWNER is NOT an EXPERT FIREMAN. The DRAFT GAUGE will help to TELL HIM whether the fireman is EXPERT or NOT

V

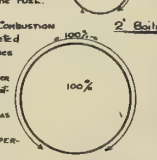
Drawing No. 73.

BOILER FLUES.

Hand Firing No. 27

The SIZE of the Boiler FLUE has considerable EFFECT upon the ECONOMY of the FUEL.

With a 2 inch flue the proportion of Cooling SURFACE of the flue as compared with its cross-sectional area of GAS is 191 per cent. With a 3 inch flue it is 127%. With a 4 inch flue it is 100%. From this you will see that the size of the flues will have considerable effect upon the production of SMOKE. If combustion is not completed in the FURNACE proper.



2' Boiler Flues.

4' Boiler Flues

When COMBUSTION is NOT completed before the gases reach the FIRE FLUE. The smaller the flue the greater the loss by CHILLING the GAS & BELOW the IGNITION TEMPERATURE.

Soot will also RETARD the FLOW of GASES.

Note the reduction in effective area of the flue which will be occasioned by an ACCUMULATION of SOOT.

W.

Drawing No. 71.

ACTION OF THE AIR THROUGH THE GRATES IN THE FIREBED.

Hand Firing No. 26.

Heated Tests made by the U.S. BUREAU OF MINES and by the ILLINOIS UNIVERSITY have proved beyond doubt that the AIR SUPPLIED THROUGH THE GRATES only PROVIDE OXYGEN for completely burning HALF of the FUEL.

At a point in the fuel-bed at from 2 to 4 inches above the grates, (depending upon the thickness of the fuel bed) the GAS ANALYSES as COMPLETE COMBUSTION, as MAXIMUM CO_2. ($CARBON-DI-OXIDE$)

As the CO_2 passes through the remainder of the fuel bed. One of the two parts of OXYGEN picks up another part of CARBON and by the time that it reaches the TOP of the FUEL-BED The RESULTANT GAS has been changed to CO or (CARBON MON-OXIDE) Containing practically TWO THIRDS of the HEAT VALUE of the COAL

Under PRACTICAL OPERATION some

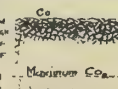


Fig 1.

GREEN ASH has been pointed through the FIRE-bed of some part which has burned some of the gas to CO_2 leaving approximately HALF of the heat value instead of Two Thirds in the RESULTANT GAS. This applies to all thick nesses of FUEL BED. THINNING the fires results in more fuel dam for passing the air and gas through the bed, and causes a more intense heat which aids in breaking up the gases quicker. (See Fig 2 DOTTED LINE being the MAXIMUM CO_2 LINE)

The possible EXCEPTION to the above RULE being the LOCOMOTIVE Due to the intermittent high DRAFT (occasionally as high as 15 inches) the fuel BED is LIFTED and BROKEN. Allowing at these times an EXCESS of air through the fires before DROPPING back to the grate. The fuel bed being practically floating on the air

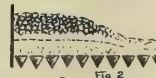


Fig 2

X.

Drawing No. 87

FIRING the HEATING BOILER.

Hand Firing No. 87

The boilers used strictly for LOW PRESSURE steam HEATING is usually fired upon a DIFFERENT system to the regular Hand Firing of the High Pressure Steam boiler

For Steam Power a REGULAR FIREMAN is required in attendance at all times so that the minimum and economic conditions may be under control and obtained.

The Fuel in the Heating boiler is burned under different conditions The FULL HEAT VALUE of the fuel is not developed in the FIRE BED to the extent that applies with the Power Boiler. Conditions are comparable to a GAS PRODUCER compared with a POWER BOILER.

In the Gas Producer

GAS PRODUCER (Diagramatic)

the heat which is developed in the fuel bed is used entirely to bake the gas out of the coal and to burn up the carbon into CARBON MONOXIDE. NO COMBUSTION can take place on the top of the fire as no air is admitted on top. The RATE of COMBUSTION being controlled entirely by the air ADMISSION under the grate

The Heating boiler is operated under similar conditions except that air is admitted on top in order to BURN the GAS

The Ash Pit Damper is regulated to control the RATE of HEAT REQUIRED

Usually a THICK FUEL BED is used, which is most practicable and economical, If the PROPER AMOUNT of AIR is ADMITTED OVER the FIRE by proper REGULATION of the DAMPERS

Y

Drawing No. 88

Firing the Heating Boiler AIR

Hand Firing No. 28

The complete combustion of the gas off the fuel depends to a great extent upon the proper MIXING of the AIR admitted over the fires with the combustible GASES.

The VELOCITY of the hot gases and the INTENSITY of the DRAFT have considerable EFFECT upon this MIXING.

With the HEATING BOILER, due to the LOW DRAFT, necessary for ECONOMICAL OPERATION; The gases off the fires are LAZY. AS air is usually admitted only at the FIRING DOOR much of the unconsumed gas comes in contact with the BOILER SURFACE and is COOLED BELOW IGNITION TEMPERATURE, before the slow moving air can come into contact with some and provide OXYGEN to complete the combustion of the gas.

FLAMES such as shown in the Figure here, will often be seen when operating under these conditions.

SNAKES of FLAME will DART and ROLL around the COMBUSTION SPACE These are in reality FLAMES INSIDE OUT

The ATMOSPHERE of the FURNACE being COMBUSTIBLE gas, while the SNAKES are occasioned by the INCOMING AIR SEARCHING through the gas.

It will be obvious that the gas mixes the closer has greater advantage for complete combustion than that off the fire further away Which LOGICALLY must result in waste of unconsumed gas.

You may not see smoke under these conditions, but your FUEL LOSS may be ONE THIRD

Z.

Drawing No. 89.

The Value of Coal Sizes. Lump.

Hand Firing No. 22

12 inch LUMPS have 6 ft square surface.

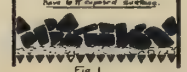


Fig 1

Burned down to 6 inch it has ONLY 2 ft surface.

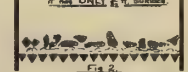


Fig 2.

The pressure about demonstrated that it required as much surface as possible in contact with the fire in order to bake out the combustible gases. These gases once burned in the space over the fire by means of the oxygen admitted over the fires.

AFTER the gases have been baked out there remains the CARBON content of the fuel which has to be burned under different conditions.

The GRATES are required to support the fuel, and have SPACES to admit AIR to the FUEL. The OXYGEN in the air as admitted comes in contact with the RED HOT CARBON and combines with the carbon. This combustion of the carbon takes place on the SURFACE of the Carbon, gradually EATING away the surface until all is finally consumed.

If your coal is in LUMPS there is less surface for the oxygen to work on.

ALSO NOTE:— As the lumps burn there is a continual reduction in the surface in contact with the oxygen for combustion.

Starting with 12 Lump you have

6 ft	DIMINISHED	
BURNED DOWN TO	6	you have 6 ft.
" " "	3	" " 3 "
" " "	1½	" " 1½ "

Can You expect Results with LUMP COAL unless you are prepared to put in a lot of LABOR breaking coal in the FIRE and filling in BETWEEN the LUMPS.

Drawing No. 54. AE.

If the concrete is lath and plastered on the inside you have a better heat resisting wall than solid stone, and as the surface is so much smoother, the air space acting to keep the interior surface dryer, it is to be preferred. It is easier kept free from mould and fungus.

All floor joists should be filled in to prevent leakage of air into basement.

A well built frame building is warmer than a solid brick building, for the reason that each layer of the various material used, plaster, paper, rough boarding, paper and siding, acts as a break and provides an air space between each separate material.

Brick should be built as two separate walls with an air space between the air space broken about every three feet in height. It should be lath and plastered inside, and should preferably be lathed and stuccoed outside.

Casings of doors and windows should be well fitted and should be caulked with felt to take care of the contraction which occurs during the weathering of the wood.

Ceiling joists between ceiling and roof should be rough boarded and papered. This is often neglected and is the cause of complaint of cold houses.

If your house is cold and you know that it is due to the bad construction of the walls, do not continue to try and heat the whole of Western Canada. The least expensive way of curing the trouble is to line the inside walls with "Beaver" or some "other brand" of Wall Board. Before putting on the wall board, however, get some building paper and tack this on to the walls which are cold. The paper should be put on longitudinally, the reverse of wall paper, pasting or tacking the top edge and letting one layer overlap the other similar to shingles. This will make two additional air gaps to prevent the transfer of the heat from the beaver board to the plaster of the wall. Rooms done in this manner can be made very artistic in addition to their value in heating.

Before putting on the wall board the base board should be removed and the plaster filled in where it has been broken away or left undone.

STORING COAL

Any of the Alberta Domestic Coals may be stored in the coal bin from one season to another without deterioration,

COAL TRUTHS FOR OWNER AND FIREMAN. No. 4

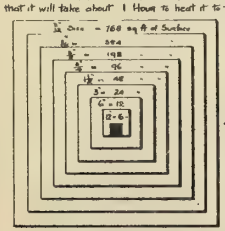
The Value of Coal Sizes Lump

COAL is a BAD CONDUCTOR of HEAT. The gases cannot be baked out of a piece of coal unless it is heated to a sufficiently high Temperature

The Outside of a piece of coal may be WHITE HOT, but as the coal is a poor conductor of heat the inside may be relatively cold, if fired in LARGE LUMPS If you use lumps you must allow time and slow fire to heat the coal to the center. When a WOMAN bakes a LOAF of BREAD she estimates that it will take about 1 Hour to heat it to the center. But - if baking a BISCUIT she knows that it will only take minutes to heat to the center.

Your coal has the same conditions as the loaf or biscuit; according to the size. Time must be allowed to cook it. Heat is only absorbed according to the surface in contact with the heat: ONE CUBIC FOOT of Coal in the sizes here given will expose a surface in proportion which SHOULD DEMONSTRATE that you cannot get maximum heat or full Steam SERVICE by using Lump

A WOMAN would make a good FIREMAN. SHE BUILDS HER FIRE To SUIT HER LOAF



Gilbert Colman

B2 TAKE A LESSON ON FIRING FROM YOUR WIFE

Drawing No 55.

The Value of Coal Sizes Lump 2

Hand Firing No 85

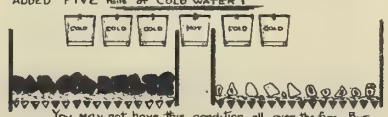
The 2 preceding charts demonstrated the low rating which can be expected by the use of Lump Coal for Hand Firing.

There is another feature which results in a further decrease in the capacity of the BOILER and is also a great loss in FUEL value

We will say that you have a condition as outlined in chart 2 Say that 9 inch LUMPS have been used and were originally placed close together on the Fire. These have BURNED off on their surfaces until they have become only 4½ inches in size

What are Your Conditions Now?

You have only one quarter of the surface of the coal working to provide heat, and you have a SPACE of 4½ inches between each lump, through which air is flowing. This AIR is not only NOT doing any work. But it is also COOLING off the gases which you have made "hot" by burning the coal. You might easily at this time have 500 per cent Too MUCH AIR YOU EXPECT HEAT to the BOILER! Would you expect 6 pails of BOILING WATER, if you had ONE pail of BOILING WATER and ADDED FIVE Pails of COLD WATER?



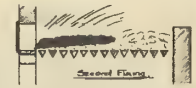
You may not have this condition all over the fire. But wherever you have PLACED a LUMP this condition EXISTS

C2 Drawing No 56.

Methods of Firing

Hand Firing No 89

Heat Firing.



Second Firing.

How the album boiler shows There is a Regular Fireman in attendance, There is the Coking Method in which the coal is fired in front. When the Volatile gas has been burned out; the Hot Coke is pushed to the Back of the GRATE

This METHOD of Firing is GOOD. BUT - Requires considerable WORK to obtain this GOOD RESULT.

There is a tendency to STIR up the ASH with the Hot Coal, forming CLINKERS.

There is also possibility of wasted fuel into the ASH PIT.

Handled properly the COKING METHOD is practically SMOKELESS. but as it requires considerable SKILL and WORK for the Fireman to Obtain this Result, the NET RESULT is that it does NOT get the service that it REQUIRES and so is not as EFFECTIVE as ALTERNATE FIRING.

As BEING MORE FOOL PROOF the ALTERNATE METHOD is RECOMMENDED and is GOOD for ALL COALS.

For the HEATING BOILER, where attention is INTERMITTENT the only method which should be considered is ALTERNATE FIRING

D2 Drawing No 72

FREE BURNING COAL

Hand Firing No 30.

Low Draft Required.

The following coals use FREE BURNING are in other words they LIGHT FREELY and MAIN LIGHTED until all Fuel is Consumed They consist of:

LETHBRIDGE FIELD, GALT, TABER, DRUMHELLER, PEMBINA, CARBON, KNEEHILL, CLOVER BAR, DINANT; ETC.

Best RESULTS are obtained with FIRE about 6 inches thick and having the DAMPER regulated CLOSE

If operating with a THIN FIRE there is usually a tendency to give it TOO MUCH DRAFT, which WASTES Fuel and SERVICE cannot be maintained

If operating with a FIRE too THICK, there is liability of CLINKER TROUBLE. As only a SMALL amount of of AIR is required there is less air passing through the Fire than is necessary to keep the ASH BELOW FUSION TEMPERATURE; resulting in CLINKER.

ALTERNATE Firing is the most satisfactory method thus method incorporates the maximum without it having an objectionable effect on the rest of the fuel bed, when the maximum is used you have a lively high value coal.

The Fire should not be DISTURBED with the POKER. Ash should be removed by FREQUENT LIGHT SHAKING of the GRATES.

When necessary to Clean the FIRE LET ONE SIDE BURN DOWN and DUMP ENTIRELY or PULL the CLINKER out through the FIRE DOOR

Most Suitable Sizes - { NUT / PEA / STOVE NUT with 10% Slack.

E2. Drawing No 63.

BITUMINOUS COALS.

Hand Firing No 31

Medium Draft Required.

The following coals are BITUMINOUS COALS being higher in Combustible VOLATILE and LOWER in MOISTURE than the FREE BURNING as preceding Plate. They consist of:-

YELLOWHEAD, FOOTHILLS, ROCKY MOUNTAIN, ETC.

They should be fired in similar MANNER to the Free burning.

BEST RESULTS are obtained with fires from 3 to 5 inches thick, Firing in small quantities at a time and OFTEN This on account of the Hydro Carbon Volatile which is more QUICKLY DRIVEN OUT than from the high moisture coals

If fired too HEAVILY and on a smothered FIRE TROUBLE will RESULT from SMOKE and SOOT.

Slightly MORE DRAFT is required than with freeburning coal.

DON'T STIR UP THE ASH with the COAL unless you have MARKET for CLINKERS.

Most Suitable Sizes - { NUT / PEA / STOVE NUT.

F2. Drawing No 64

Steam Coals. Coking.

Hand Firing No 81.

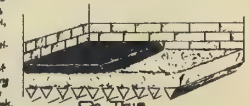
Nut stock size.

The Coking Coals of ALBERTA are CROWS NEST FIELD, CADOMIN, MOUNTAIN PARK, and others in course of Development.

The percentage of Lump is small, and firing methods are practically the same as if using stock.

If it contains much Dust it will be to advantage to wet it down before firing.

The water tends to keep the fuel bed open and improves combustion.



DO THIS.

stock coal to the OTHER SIDE of FIRE.

DON'T expect to get SERVICE by having alow LUMPS of COKE staggered over the grate and by filling in between the Lumps with stock on to the BARE GRATES.

This would mean Shovelling the coal TWICE; ONCE on to the GRATE and THEN on TO THE ASH PILE. which is not Economical and is HARD WORK.

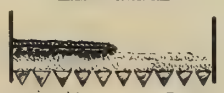
To obtain BEST RESULTS the Fire should be BUILT UP SLOWLY until it is about 3 inches in thickness all over the grate. When well alight SPREAD about 2 inches of SLACK to one side of the FIRE When this is partially BURNED break it with a RAKE or LIFT carefully with a Slice Bar and Fire

G2. DON'T DO THIS.

Drawing No 62.

Alternate Layers of Free Burning coal and Coking Stack.

Hand Firing No 32



Medium Draft Required

As noted in the previous plates the fire burning coals require careful REGULATION of the DAMPER in order to prevent waste of Fuel and best service, while the Coking Stack requires Firing and ATTENTION to obtain service.

By SPREADING ALTERNATE LAYERS of FREE BURNING COAL and COKING STACK coal Hand of coal AUTOMATICALLY CURES the DISADVANTAGE of the OTHER. The Free burning coal BORES HOLES in the Coking stack and opens it up without the use of the poker. While the coking stack acts similar to a DAMPER by REGULATING the RATE of COMBUSTION of the Fuel

Fires may be HELD for LONG PERIODS by closing down the damper and by no other attention than by opening up the damper when a HOT Fire is required Quickly.

Alternate firing as with the fuels previously described provides the BEST RESULTS. The METHOD of FIRING being to throw in 2 SHOVELS-FULL of Free Burning coal and SPRINKLE it with TWO-THIRDS of SHOVEL-full of Coking stack. This Fuel is most suitable for the HEATING boiler, where a FIREMAN is NOT in REGULAR attendance MEDIUM DRAFT REQUIRED.

The THICKNESS of the FIRE will DEPEND upon LENGTH of TIME BETWEEN FIRING.

H2 Drawing No 65.

Burning Small Coals and Slack

Hand Firing No 84

DRAFT EQUIPMENT a COSTLY.

The most SUITABLE installation is by having CLOSED ASH-PIT and FORCED DRAFT UNDER the GRATE The forced draft may be supplied by a Fan operated by steam or by electric motor. Or, it may be had by steam jet blower.

As these coals PACK very CLOSE on the GRATE; it is necessary that a HIGH DRAFT be maintained in order to obtain the capacity of the boiler by them use.

It must be understood that a high draft does NOT necessarily MEAN that a large QUANTITY of AIR is PUT through the fire. In THIS CASE the high DRAFT is required to LIFT and MOVE APART the small pieces of COAL so that just SUFFICIENT AIR may be had for PROPER COMBUSTION

The small hand fired plant is usually limited as to draft: An INDUCED DRAFT is not required.

Such an installation allows for operation WITHOUT the use of mechanical draft WHEN OTHER COALS are being USED; or when HIGH RATING is NOT REQUIRED.

As there is a TENDENCY to CREATE a PRESSURE in the COMBUSTION CHAMBER, There is LESS LOSS through the INFILTRATION of AIR cooling off the HOT gases off the fuel before they strike the heating surface of the Boiler. ALTERNATE FIRING is MOST SATISFACTORY

The COST of operating the BLOWER ranges 2 to 10% of fuel costs.

I2 Drawing No 67.

CANMORE COAL

Hand Firing No 33

Good Draft

In the fire this coal is not like any other coal produced in ALBERTA. an average ANALYSIS being FIXED CARBON-75% Volatile - 17% ASH-9% BTU-13500-14000.

The classification is between Semi-Bituminous and Semi-Anthracite.

The possible percentage of LUMP is not greater than 30%.

If handled DRY in the fire it REQUIRES CONSIDERABLE ATTENTION in order to obtain maximum SERVICE and ECONOMY but if FIRED WET, MIXED LIKE a MORTAR with about 6% of WATER, it is one of the best COALS produced for maintaining SERVICE and HIGH Overload.

While if it not cleaned as a COKING Coal, the WATER tends to make the fines SWELL and the coal becomes more FREE BURNING.

The BEST METHOD of FIRING this coal is SPOT FIRING, FILLING in the LOW SPOTS as they occur.

The POKER must NOT be used on any account with CANMORE coal. The WATER acts to keep the fuel FREE, taking the PLACE of the POKER

If required a shaking grate and preferably a GRATE that can be DUMPED to be cleaned

A GOOD DRAFT is required Thickness of Fire depends upon the SERVICE Maintained and will RANGE from 5" to 10 inches in THICKNESS.

J2. Drawing No 66.

providing that you keep the bin closed up without current of air passing over the coal. If your bin is in such shape that it cannot be closed tight cover the coal with old potato bags and sprinkle the bags occasionally with water. This will prevent coal from breaking and slacking.

Stove and nut sizes store better than lump sizes.

If convenient put in one or two tons of coal during the summer months. You can usually get a better price and are also prepared for the start of winter.

The coals mentoned here are coals which the writer was brought into contact with during the 1921 and 1922 season. From time to time other fields may be opened up. The user should obtain information on same before purchasing so that he may know how to handle them satisfactorily.

SIZES OF COALS

At the time of writing no standard of sizes of the Alberta Coals exist, but investigation is now under way in order to determine the suitable sizes which will be made standard for each District.

The Research Council of the University of Alberta in Edmonton has made experiments extending over the last few years. The finding being the following recommendation:

Stove Coal through 3 inch and over 1½ inch.
Nut Coal through 1½ inch and over ¾ inch.
Pea Coal through ¾ inch and over ¼ inch.
Nut Slack through 1½ inch.

Lump may be any size according to the conditions in which the coal is mined and also by its position in the ground. Lump coal is, in fact an unnecessary luxury for which a price is paid for no extra value received. Better heating service can be obtained with a mixture of lump and smaller sizes. When the public become adapted to this mixture it is probable that a size which might be called Screened Coal could be made standard. This would be the mine run with all sizes below 1½ inch taken out. This would make considerable reduction in cost of production.

As there is breakage every time that coal is handled the user must expect a small amount of small due to handling into the wagon and the coal bin.

The most commonly known coals on the Winnipeg markets are as below, the District name and the mine name:

DOMESTIC COALS

BANFF DISTRICT—Bankhead.

BRAZEAU DISTRICT—Saunders Creek, Alexo.

YELLOWHEAD DISTRICT—Yellowhead, Foothills, McLeod River, Sterling.

LETHBRIDGE DISTRICT—Galt, Lethbridge Imperial, Chinook.

TABER DISTRICT—Canada West, Regal.

DRUMHELLER DISTRICT—Newcastle, Newcastle Jnr., A. B. C., Rosedeer, Western Gem, Midland, Jewel, Monarch, Rosedale, Samuel Drumheller, Hy Grade, Midwest, Elgin, Western Commercial, Atlas, Shamrock, Sunshine, Wayne, Gibson, Premier, Star, Excelsior, Celtic, Yoho, Scranton.

THREEHILLS DISTRICT—Kneehill Valley.

CARBON DISTRICT—Carbon.

PEMBINA DISTRICT—Pembina Peerless.

WABAMUN DISTRICT—Lakeside, Victory.

BIG VALLEY DISTRICT—Big Valley.

CLOVER BAR DISTRICT—Humberstone, Black Diamond, Marcus, Bush.

CAMROSE DISTRICT—Dinant.

TOFIELD DISTRICT—Tofield, Dobell.

NAMAO DISTRICT—Cardiff.

TROCHU DISTRICT—Ardley, Hardite.

STEAM COALS

CROWS NEST DISTRICT—Hillcrest, International, McGillivary Creek, Greenhill, Blairmore, Bellevue.

MOUNTAIN PARK DISTRICT—Mountain Park, Cadomin, Luscar.

JASPER PARK DISTRICT—Blue Diamond.

CANMORE DISTRICT—Canmore.

BRAZEAU DISTRICT—Saunders Creek, Alexo.

YELLOWHEAD PASS DISTRICT—Yellowhead, Foothills, McLeod River, Sterling.

Also small sized coals which are put up especially for steam use by some producers of the other domestic coals, such as Lethbridge and Drumheller Districts.

PART 2
STEAM BOILERS
SMOKE

Black smoke is an unnecessary nuisance, no matter what kinds of coal used.

Coals which contain the oiley high volatiles require more careful attention to rules than those with the lower volatiles.

The higher the volatile content of the coal the more the need of large combustion space in which the gases can be consumed before they pass to the heating surfaces. If this is not obtainable with your equipment, better attention on the part of the fireman must be used to overcome this.

A strict enforcement by municipal authorities of smoke abatement laws would in the long run be profitable to the offenders. Smoke, service and economy do not go together, by eliminating the first (smoke) it automatically brings the others into line.

It is necessary, however, that the authorities do more than complain about smoke, to get results they must co-operate with educational work, showing how the smoke may be eliminated, and to insist that new installations are made whereby this result can be obtained.

Much more attention must be paid to the boiler room by architects and Heating Engineers when designing a building. The heating equipment and service is the HEART of the building and should not be delegated to the last and put in some out of the way corner where it is an everlasting expense to the owner and an everlasting . . . . to all tenants and attendants.

Consider it on a horse sense basis, located to provide the greatest amount of heat where wanted, for the least amount of fuel and unskilled attention, not forgetting that you have to provide for getting the coal in conveniently and have ashes to take away.

There will come a time when the owner will have to pay for extra cost of delivering coal in next to the impossible corners instead of the present system of putting this expense up to the coal dealer.

The Plates Nos. 1, 2, 3 and 4 are included for the perusal of the fireman, engineer and owner of the large plant.

Fig. A, Plate 1, shows the usual setting for a return tube boiler, and also shows common method of firing, the coal piled as high as possible. Fig. B shows the same setting, with coal fired in better manner, candle shows waste which must be expected by this design. Fig. C shows the improvement which is obtained by increasing the distance of the boiler from the grate. A glance at the candle will show the logic of the arrangement.

Fig. D shows the common trouble with the brickwork, leaking air and consequently wasting fuel. Figs. E, F, G and H are common understandings of the work of the fireman, where a fireman is hired to shovel coal rather than to use intelligence. Figs. I and J to O inclusive on Plate 2 show the methods which would be employed on the same plant where a fireman was hired to use brains rather than muscle. Fig. P shows the savings made by such method.

Figs. Q and R show the proper firing tools which should be provided. Fig. S Plate 3, good and bad methods of furnace brick setting. Figs. T and U, losses due to draft and air leakage. Fig. V, the savings which can be effected by use of the draft gauge. Fig. W, a word on boiler flues Fig. X, where you get best combustion in the fire. Figs. Y and Z a comparison of the heating furnace with the gas producer. Fig. Az mistakes made with lump coal. Fig. Bz, Plate No. 4, illustrates the greater efficiency of small coal compared with lump coal, upon a basis of time required to heat the coal to ignition temperature. Fig. Cz, the loss due to excess air which is usual when burning lump coal. Fig. Dz shows the coking method of firing coals. Fig. Ez, the method of firing the free burning coals for steam purposes with the draft required. Fig. Fz, the alternate method of firing bituminous coal with draft regulation required. Fig. Gz, one of the best methods of firing coking coals. Fig. Hz shows economy by using mixture of free burning coal and coking slack and its lasting qualities, with draft required. Fig. Iz illustrates system of forced draft for burning the by-product slack coals, and Figs. Jz shows value of semi-anthracite and its method of firing by adding large amount of water.

All the above illustrations have text on face fully describing the subject outlined. A study of these may give the reader pointers for improvement at his own plant.

As this book is issued primarily for the Domestic user, the subject here is not of general interest, and has been crowded in with the thought that those interested could at little trouble with a magnifying glass, cover the whole subject of the small steam boiler. To those not interested in this section we would offer our regrets at what to them would be a waste of space, valuable or not according to their viewpoint.

To those who are interested the writer would advise that these pictures and a full extension of the subject is in lantern slide form for their use when desired, and which it is hoped to extend to cover all fuels and equipment used in connection with same.

The suitable coals which are produced in the Province of Alberta are:

Coking Coals, commonly called Steam Coals, from the Crows Nest District, Mountain Park District and Jasper Park District. Canmore, which is a semi-bituminous, also bituminous coals, such as Yellowhead, Brazeau and Saunders Creek.

The name steam coals has become established by reason of the fact that until the advent of the Alberta coals in the Winnipeg market the only coals were anthracite, as used by the Domestic user, and soft coals, as used for the steam plants originating in the U. S. A.

The above mentioned coking Alberta Coals are similar in characteristics to the U. S. A. soft coals.

As the user attains a better knowledge of the Domestic coals a much greater use of the small sizes of the domestic coals will be used for generating steam, particularly on the heating boilers where it is desired to leave considerable time between firings.

GEO. R. PRATT, A.M.E.I.C.

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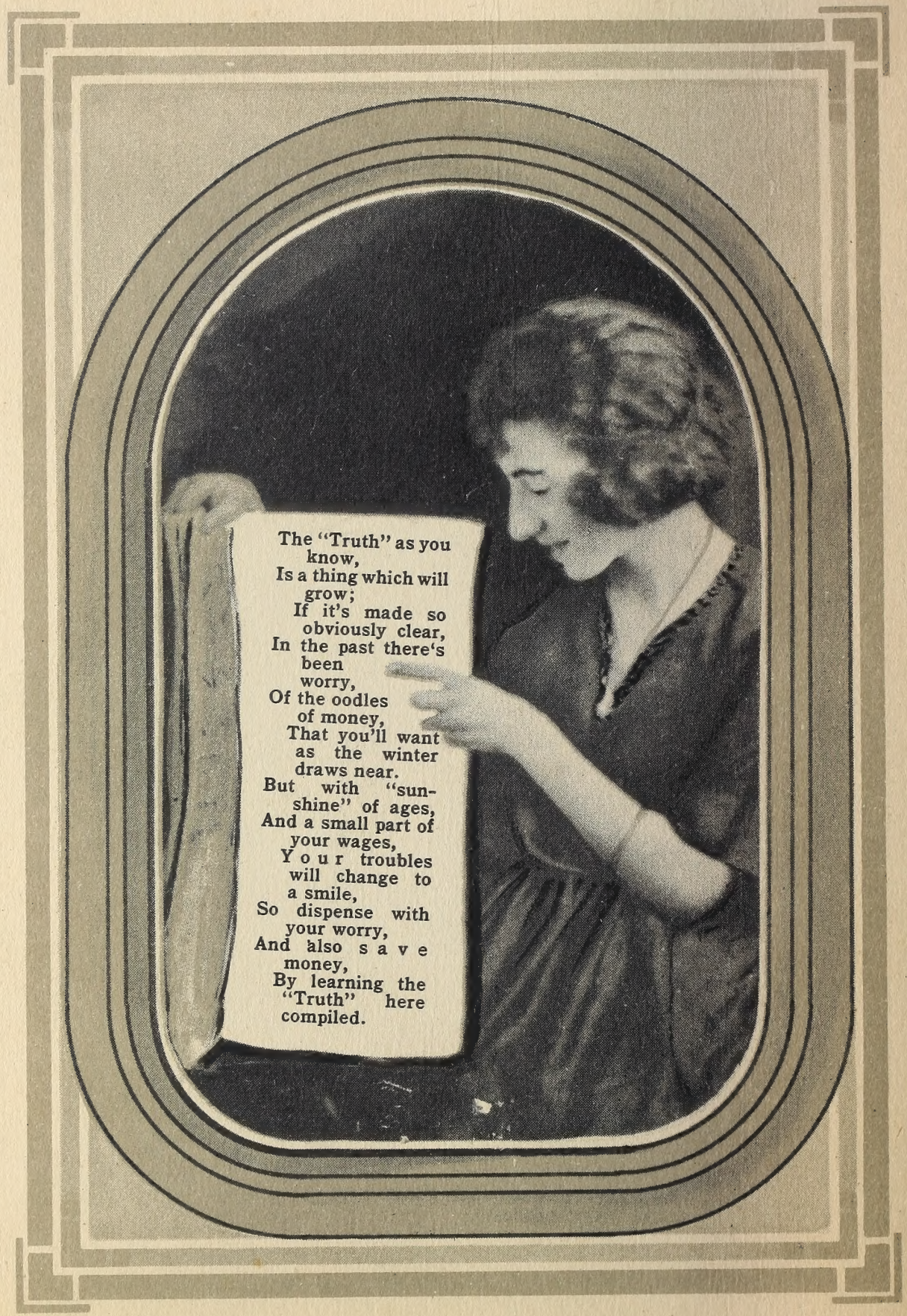
The "Truth" as you know,
Is a thing which will grow;
If it's made so obviously clear,
In the past there's been worry,
Of the oodles of money,
That you'll want as the winter draws near.
But with "sunshine" of ages,
And a small part of your wages,
Your troubles will change to a smile,
So dispense with your worry,
And also save money,
By learning the "Truth" here compiled.